31761 .J128

U.S. Cost and Geodetic Survey
Safeguard the gateways of
Alaska

VK
597
U55
1918

Gov. Doc.
rial No. 87

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
E. LESTER JONES, SUPERINTENDENT

SAFEGUARD THE GATEWAYS OF ALASKA

HER WATERWAYS

By

E. LESTER JONES
SUPERINTENDENT

UNIVERSITY OF TORONTO
LIBRARY
JUN 6 1921

Special Publication No. 50

WASHINGTON
GOVERNMENT PRINTING OFFICE
1918

Serial No. 87

DEPARTMENT OF COMMERCE
U. S. COAST AND GEODETIC SURVEY
E. LESTER JONES, SUPERINTENDENT

SAFEGUARD THE GATEWAYS OF ALASKA

HER WATERWAYS

By

E. LESTER JONES
SUPERINTENDENT

Special Publication No. 50

WASHINGTON
GOVERNMENT PRINTING OFFICE
1918

UNIVERSITY OF TORONTO
DEC 10 1970
LIBRARY

SAFEGUARD THE GATEWAYS OF ALASKA

HER WATERWAYS

VK
597
U55
1918

CONTENTS.

Page.

Historical 5

CHAPTER I.—INTRODUCTORY.

General description of coast 9
Extent of the general coast lines 9
Weather conditions 10
Many undeveloped harbors of Alaska 11
History of surveys 11
Total cost of Alaska coast surveys for 50 years (table) 14
Surveying vessels of the past 14

CHAPTER II.—PRESENT CONDITIONS.

How little the present charts mean to mariners 16
The causes of wrecks 18
Loss of the U. S. revenue cutter *Tahoma* 19
Inadaquate surveys 20
Loss of steamer *Yukon* 22
Currents a big factor in navigation 22
What the toll has been in wrecks 23
Why unsurveyed waters retard Alaska's development 24

CHAPTER III.—LOOKING INTO THE FUTURE.

Complete surveys needed 27
Study of currents important 28
Modern vessels needed 28
Importance of wire drag 30
Wire-drag launches should be built and not hired 31
Time required to make a first survey 33
Probable cost 33
More trained officers essential 34
Crews for vessels a vital need 35

CHAPTER IV.—FIRST SURVEYS OF *INTERIOR* ALASKA NEEDED.

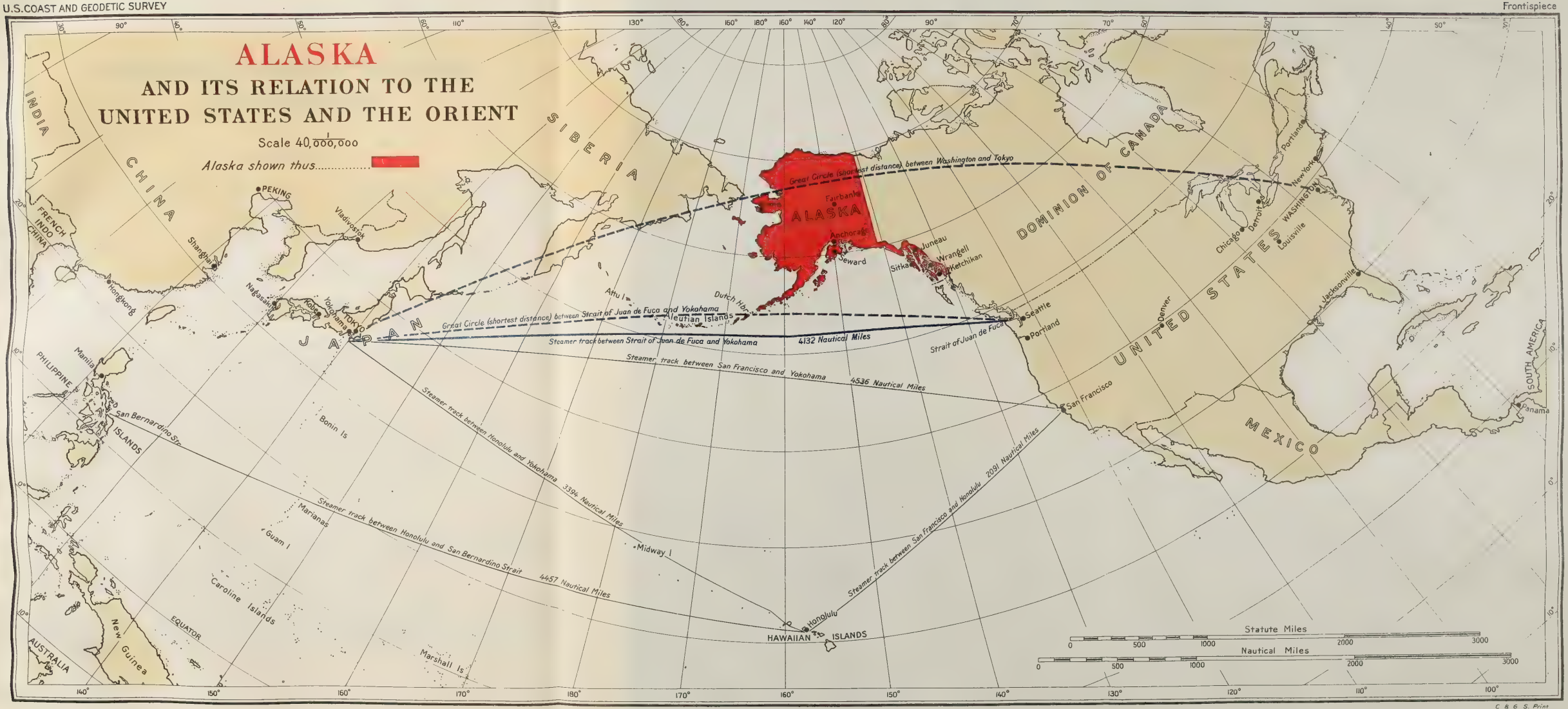
Character of work needed 38
Where control surveys should be made 39
Topographic engineers and mineral surveyors need elevations, latitudes, and longitudes 40
What other countries have done 40

CHAPTER V.—CONCLUSION.

Alaska's greatest need 41
Future 41

ILLUSTRATIONS.

		Following page
Frontispiece.	Alaska and its relation to the United States and the Orient	4
1.	Comparative diagram, United States and Alaska	6
2.–7.	Alaska's resources and present development	8
8.	Characteristics of Alaska's coast line	8
9.	Pinnacle rocks	8
10.	United States Coast and Geodetic Survey schooner *Yukon*	14
11.	United States Coast and Geodetic Survey steamer *Hassler*	14
12.	United States Coast and Geodetic Survey steamer *Gedney*	14
13.	United States Coast and Geodetic Survey steamer *McArthur*	14
14.	United States Coast and Geodetic Survey steamer *Patterson*	14
15.	United States Coast and Geodetic Survey launch *Cosmos*	14
16.	United States Coast and Geodetic Survey steamer *Taku*	14
17.	United States Coast and Geodetic Survey steamer *Yukon*	14
18.	United States Coast and Geodetic Survey steamer *Pathfinder*	14
19.	United States Coast and Geodetic Survey steamer *Explorer*	14
20.	United States Coast and Geodetic Survey steamer *Surveyor*	14
21.	Comparative water surveys of Alaska and Philippine Islands	16
22.	Coast of Dall Island, *unsurveyed*	18
23.	Coast of Dall Island, surveyed	18
24.	Coast of Chichagof Island, *unsurveyed*	18
25.	Redfish Bay, Baranof Island, *unsurveyed*	18
26.	Montague Island, Prince William Sound, *unsurveyed*	18
27.	Nagai and Little Koniuji Islands, Shumagin Group, *unsurveyed*	18
28.	St. Matthew Island, Bering Sea, *unsurveyed*	18
29.	Aleutian Islands, *unsurveyed*	18
30.	United States revenue cutter *Tahoma*, August, 1914	20
31.	United States revenue cutter *Tahoma*, *wrecked*, September, 1914	20
32.	Steamer *State of California*, wrecked in 1913	20
33.	Wreck of steamer *Yucatan*	20
34.	Wreck of steamer *Delhi*	20
35.	Wreck of steamer *Mariposa*	20
36.	Uncharted rocks, Gambier Bay—cause of wreck of steamer *State of California*	20
37.	Wreck of steamer *Yukon* on Sannak Island	22
38.	Supposed and actual track of steamer *Yukon*	22
39.	Statement of Alaska's strandings and wrecks, 1900 to 1917	24
40.–42.	Strandings and wrecks in Alaska 1900 to 1917	24
43.–46.	Rocks recently found by wire drag in main steamer routes, southeast Alaska ("Washington Monument.")	30
47.	Control surveys now needed, interior Alaska	38
48.	Knowledge of elevations now needed, interior Alaska	38
49.	First control surveys completed in British India	40
50.	Known elevations in British India	40


ALASKA
AND ITS RELATION TO THE
UNITED STATES AND THE ORIENT
Scale 40,000,000
Alaska shown thus
Great Circle (shortest distance) between Washington and Tokyo
Great Circle (shortest distance) between Strait of Juan de Fuca and Yokohama
Steamer track between Strait of Juan de Fuca and Yokohama 4132 Nautical Miles
Steamer track between San Francisco and Yokohama 4536 Nautical Miles
Steamer track between Honolulu and Yokohama 3394 Nautical Miles
Steamer track between Honolulu and San Bernardino Strait 4457 Nautical Miles
Steamer track between San Francisco and Honolulu 2091 Nautical Miles
Statute Miles
Nautical Miles
INDIA
CHINA
SIBERIA
FRENCH INDO CHINA
PEKING
Vladivostok
Shanghai
Hongkong
Nagasaki
Kobe
Yokohama
TOKYO
JAPAN
Attu I
Aleutian Islands
Dutch Harbor
ALASKA
Fairbanks
Anchorage
Seward
Juneau
Sitka
Wrangell
Ketchikan
DOMINION OF CANADA
UNITED STATES
WASHINGTON
Portland
New York
Chicago
Detroit
Louisville
Jacksonville
Denver
Seattle
Portland
Strait of Juan de Fuca
San Francisco
MEXICO
SOUTH AMERICA
Panama
Manila
PHILIPPINE ISLANDS
San Bernardino Str.
Bonin Is
Marianas
Guam I
Caroline Islands
Midway I
Honolulu
HAWAIIAN ISLANDS
EQUATOR
New Guinea
AUSTRALIA
Marshall Is

C & G S. Print

SAFEGUARD THE GATEWAYS OF ALASKA:

HER WATERWAYS.

HISTORICAL.

Alaska was purchased from Russia in 1867 by the United States for $7,200,000. This purchase price was returned to the United States Treasury many years ago in royalties alone, paid by the Alaska Commercial Co. in connection with their lease, which was consummated in 1870, for the killing of fur seals on the Pribilof Islands, Bering Sea, and thereafter this vast Territory was a clear asset, and its enormous value no one dares even now to estimate.

The Territory has just celebrated its fiftieth anniversary, and present and future development of this empire is being looked upon with wonder and amazement by the people of continental United States and the world at large.

It is peculiarly appropriate in the proper development of any frontier territory to look to the safeguarding of its people, and the safety in erecting the foundation paves the way for future success.

The Coast and Geodetic Survey is a very interesting and vital agency in the safe development of Alaska. It can be said with no fear of being contradicted that on this arm of the Federal Government rests, and properly should rest, the responsibility of erecting the steel structure, so to speak, in building up this great Territory.

Alaska, with its more than 26,000 miles of detailed coast line, can not be approached without plying the waters that nearly surround it. On the east are gigantic mountain ranges that may never be surmounted by railroads. Therefore the only means to get to the seaport towns of Alaska and the interior is by ships. It thus follows that the protection of these vast water areas by the most careful surveys in locating hidden dangers is the essential step in the Territory's proper development. Alaska's waterways are her gateways and her highways of commerce, and certainly the first protection should be given these before the interior can have its proper development.

The President of the United States, in two annual messages, referred to the necessity of developing Alaska, and, in the second, he refers specifically in the closing words of his message to the Congress of the United States, informing them that it was necessary for the protection of human life and commerce to provide ships, equipment, officers, and men without delay for surveys in safeguarding the gateways of Alaska—her waterways.

From President Wilson's message to Congress, dated December 2, 1913:

> A duty faces us with regard to Alaska which seems to me very pressing and very imperative; perhaps I should say a double duty, for it concerns both the political and the material development of the Territory. * * * Alaska, as a storehouse, should be unlocked. One key to it is a system of railways. These the Government should itself build and administer, and the ports and terminals it should itself control in the interest of all who wish to use them for the service and development of the country and its people.

But the construction of railways is only the first step; is only thrusting in the key to the storehouse and throwing back the lock and opening the door. How the tempting resources of the country are to be exploited is another matter to which I shall take the liberty of from time to time calling your attention, for it is a policy which must be worked out by well-considered stages, not upon theory, but upon lines of practical expediency. It is part of our general problem of conservation. We have a freer hand in working out the problem in Alaska than in the States of the Union; and yet the principle and objects are the same, wherever we touch it. We must use the resources of the country, not lock them up.

And, again, from President Wilson's message to Congress of December 8, 1914:

There is another matter of which I must make special mention, if I am to discharge my conscience, lest it should escape your attention. It may seem a very small thing. It affects only a single item of appropriation. But many human lives and many great enterprises hang upon it. It is the matter of making adequate provision for the survey and charting of our coasts. It is immediately pressing and exigent in connection with the immense coast line of Alaska, a coast line greater than that of the United States themselves, though it is also very important indeed with regard to the older coasts of the continent. We can not use our great Alaskan domain, ships will not ply thither, if those coasts and their many hidden dangers are not thoroughly surveyed and charted. The work is incomplete at almost every point. Ships and lives have been lost in threading what were supposed to be well-known main channels. We have not provided adequate vessels or adequate machinery for the survey and charting. We have used old vessels that were not big enough or strong enough and which were so nearly unseaworthy that our inspectors would not have allowed private owners to send them to sea. This is a matter which, as I have said, seems small, but is in reality very great. Its importance has only to be looked into to be appreciated.

To add anything to the above relative to the imperative and vital need of this work is absolutely unnecessary, as the head of our country has voiced its urgent need.

It will be shown later in more detail just what this Bureau has endeavored to do in surveying the waters of Alaska, and how little it has been able to do for lack of proper vessels and officers and men and funds for efficiently carrying on this work. It will be interesting to know, however, that in 50 years they have had to spend in Alaska on this work only $3,995,906, or an average annual expenditure of $79,918. The appropriation in 11 years for the construction and maintenance of military and post roads, bridges, etc., for the interior of Alaska has been $2,120,000, or an average annual appropriation of $192,778. In 1915 Congress appropriated for a Federal Government railroad from Seward to Fairbanks $35,000,000. These figures are given not in a spirit of criticism but, on the other hand, with praise and entire approval of spending these sums in the development of Alaska, simply to show what a small proportion the Coast Survey has had, which has resulted in great retardation of work that should invariably precede development of a new country. In comparison with the amounts given for these other two objects it is a mere pittance.

The Survey has had a difficult problem to contend with in this half century's work in Alaska. It has been sorely handicapped with vessels that were in most every instance not adapted to the work in Alaska, and unable many times to cope with the unusual weather conditions of that region. Many times the officers and crews of these craft have had to cease operations and seek harbors of refuge from storms, which often put not only their lives but the vessels as well in actual jeopardy.

The exports from Alaska for the past 50 years have amounted to about $708,000,000, reaching a high-water mark the past year of about $94,709,359, and this does not include, of course, the great amount of fish, lumber, and other products of the Territory that has been consumed by its population.

The imports to Alaska for the past 50 years have amounted to $412,400,000, reaching the high-water mark in 1917, $44,431,600. These figures are to show briefly the enormous amount of shipping necessary to handle this large amount of trade.

COMPARATIVE DIAGRAM SHOWING COAST LINE AND AREAS OF THE UNITED STATES AND ALASKA

U.S Coast and Geodetic Survey

C & G S Print

Continental United States .....

ALASKA .....

For the first 30 years after the purchase of Alaska by the United States a few small vessels only were required for the commerce between Alaska ports and the ports on the Pacific coast of continental United States. In 1917 there were not only 3,963 vessels, with a tonnage of 1,818,312, entering and clearing Alaska, but instead of having vessels of 10 or 12 feet draft, as were the earlier ones, we now have them up to 28 feet. In other words, when the work of the Coast and Geodetic Survey is at its lowest ebb there, Alaska's prosperity is greater than ever before.

Few people realize or even think of the Territory's enormous area. From Dixon Entrance, on the international boundary line, to the farthest Attu Island it is nearly 3,000 miles. Along this stretch of coast there are about 465 islands in Alaska containing one or more square miles, and innumerable smaller ones. The longest island is Prince of Wales, 131 miles long and 39 miles wide, while Kodiak Island has the largest area, 101 miles long and 63 miles wide—equal to the combined areas of Connecticut and Rhode Island.

The total area of Alaska is 586,400 square miles, or nearly twice the size of the original 13 States of the Union. To this we can add 7 other States east of the Mississippi River and still we do not have the amount of area in Alaska. Norway, Sweden, Finland, England, Scotland, and Ireland do not contain as much territory as Alaska. Germany, France, and Spain have only a trifle more area than this Territory.

As to the water areas, the 26,000 miles of coast line have already been mentioned, or about 6,000 miles more than the entire Atlantic, Gulf, and Pacific coasts of continental United States.

If the map of Alaska is placed over that of continental United States, with the town of Ketchikan (in the southeastern corner of Alaska) on Jacksonville, Fla., the western island of the Aleutian Group will be found at Santa Barbara, in California. (See fig. 1.)

Alaska's high mountains have their snow fields and glaciers. They are the loftiest and greatest in North America and cover a broad expanse of area. On the other hand, Alaska has wide areas of valley lands, timber, and has many varieties of climate, as varied as can be found in the Eastern or Middle States, controlled largely by the number of mountain ranges, also by the Pacific Ocean, which has the same effect on the climate of Alaska as the Atlantic Ocean has on Great Britain and Norway.

Although Alaska has been in our possession for a half century, ignorance of its varied climate has been widespread, as has also the general misunderstanding of its winters. It has led to not a few blunders both in the administration of the Territory and also in plans for its investigation and development. Many people to this day speak of it as the land of ice and snow and few realize that part of this Territory has a temperate climate. (See frontispiece.)

The permanent snow and ice fields of Alaska are situated on the mountain slopes, as they are on the Swiss Alps, and cover only a very small percentage of the total area.

In comparing Alaska with other countries of similar latitude and climate a close relationship is found to Finland, a country of considerable agricultural importance. Finland and Alaska are largely included between the parallels 58° and 70° north latitude. Alaska is bordered on the north by the Arctic Ocean, and Finland nearly touches the Arctic. The cultivated area in Finland comprised about 7,000,000 acres in 1901, while Alaska is supposed to have *64,000,000 acres* of land available for agricultural pursuits, including grazing. In one recent year Finland produced 36,731,660 bushels of grain, 29,887,398 bushels of potatoes, and other marketable farm products. The output of butter for one year amounted to 26,585,600 pounds. Finland exported in one year $8,679,400 worth of live animals, meat, game, and butter products, and $46,012,100 worth of wood pulp, paper, and manufactures of wood. These figures are given simply to show what a country similar to Alaska is producing on *one-ninth* of the available land.

The most promising outlook for exports from the Cook Inlet-Susitna and Tanana Valley portions of Alaska is in the raising of stock and production of dairy products. The experiments at Kenai, on Kenai Peninsula, by a station of the Agricultural Department, showed that cattle could be successfully raised here and that milk and butter could be satisfactorily produced, using only locally-produced feed. Cattle raising and dairying also have proved successful in the Tanana Valley.

At present these industries are not of great importance in Alaska, but eventually the entire region may be devoted to them. Possibly the greatest profit will be derived from the production of milk, butter, and cheese. Under practically the same conditions of climate dairying has proved successful in Finland.

Too much emphasis can not be laid on the great mineral resources of the Territory. Since mining was started 33 years ago in Alaska, the amount of gold, silver, copper, and other minerals exported has amounted to $394,739,691. Of this, copper and gold stand out as leading in value. With the great amount of money that has been realized from such resources, it must not be lost sight of that difficulties and cost of interior transportation make it profitable to operate only the richer mines. When the country is further developed a great increase in the value of mineral output may be expected, due to the possibility of working lower grade ores. There are known to be great coal fields, none of which have been developed commercially at this time. (See figs. 2, 3, 4, 5, 6, and 7.)

From the well-developed fishing industry, the most important variety of which is salmon, there has been realized $298,988,852 in the last half century. Other resources covering the same period are: The skins of fur seals, $53,278,561; and from the land fur animals, $26,032,035.

In the following chapters it is the endeavor to show in a clear and practical manner, and with the omission of unnecessary detail, by text and illustration, what the Coast and Geodetic Survey has endeavored to do with scant funds toward the important work of properly charting the waters of Alaska, and what is needed for the rapid, prompt, and efficient surveys in the development of the last frontier of North America; and also to indicate the wire-drag surveys needed to make the waterways safe for navigation, and to outline the interior work required to establish survey points and elevations for the control and coordination of surveys of other branches of the Federal Government or by private enterprise. Many fine harbors with accessible riches adjacent thereto are not developed, due to the lack of surveys, and are therefore dangerous to navigation. Vessels with human lives have gone to the bottom in an effort to take advantage of opportunities to encourage shipping and to open mines in these localities. This should no longer be necessary.

COMMERCE OF ALASKA BY 5-YEAR PERIODS FOR 50 YEARS (PARTIALLY ESTIMATED).

[Given to nearest $100,000.]

Years.	Imports.	Exports.	Total.	Years.	Imports.	Exports.	Total.
1868–1872.....	$1, 400, 000	$8, 100, 000	$9, 500, 000	1898–1902.....	$68, 600, 000	$65, 400, 000	$134, 000, 000
1873–1877.....	2, 800, 000	9, 700, 000	12, 500, 000	1903–1907.....	71, 100, 000	111, 100, 000	182, 200, 000
1878–1882.....	2, 200, 000	14, 000, 000	16, 200, 000	1908–1912.....	95, 800, 000	158, 900, 000	254, 700, 000
1883–1887.....	4, 400, 000	17, 500, 000	21, 900, 000	1913–1917.....	141, 000, 000	267, 500, 000	408, 500, 000
1888–1892.....	9, 200, 000	26, 700, 000	35, 900, 000				
1893–1897.....	15, 900, 000	29, 100, 000	45, 000, 000	Total...	412, 400, 000	708, 000, 000	1, 120, 400, 000

Placer mining at Nome.

Dutch Harbor, Aleutian Islands, now abandoned; should be owned by Federal Government.

Homes at Ketchikan, Alaska.

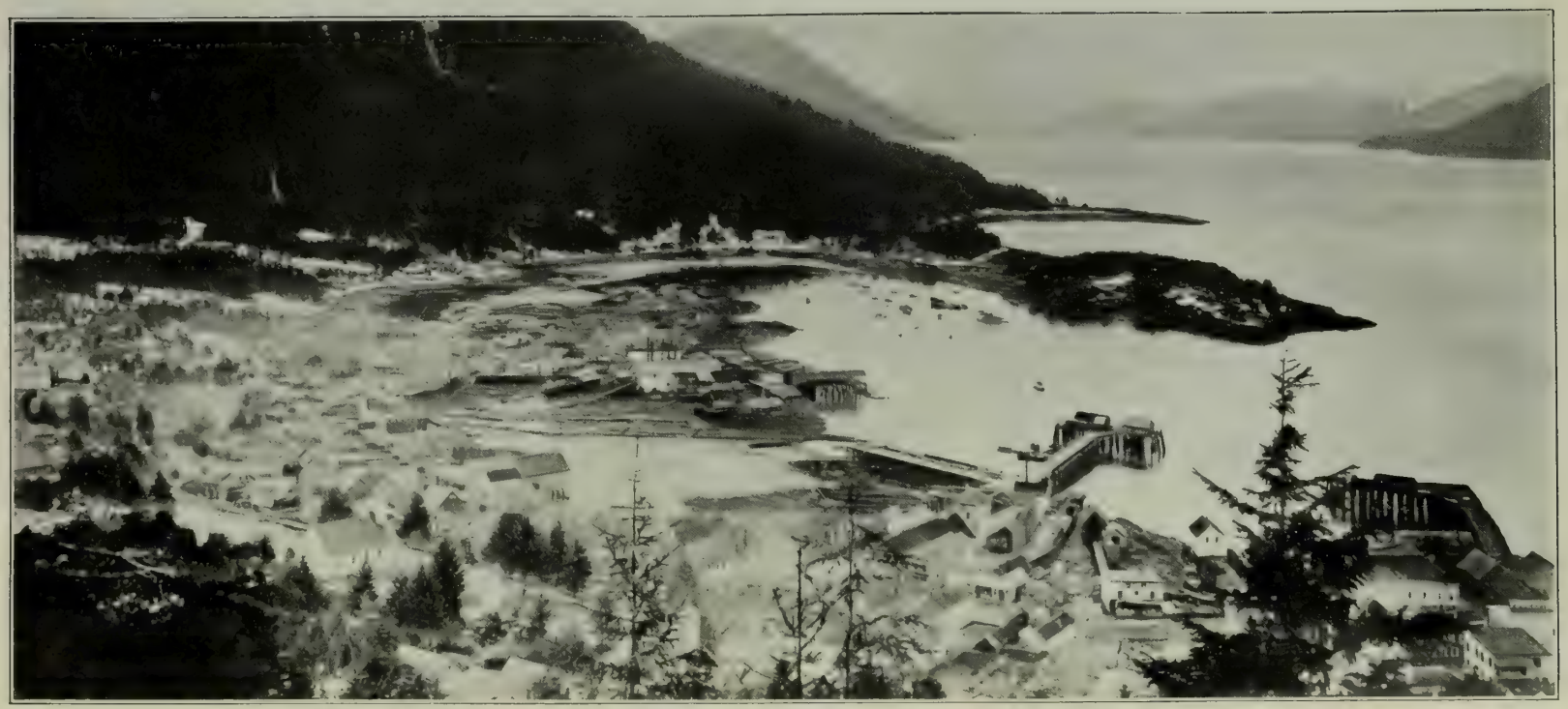
Juneau, Alaska, governor's mansion in foreground.

The thriving new town of Anchorage, Alaska.

One of the large Alaska gold mines.

Hundreds of barrels of salted salmon.

Nome, the far northwestern town of Alaska.



The beautiful town of Wrangell, southeast Alaska.

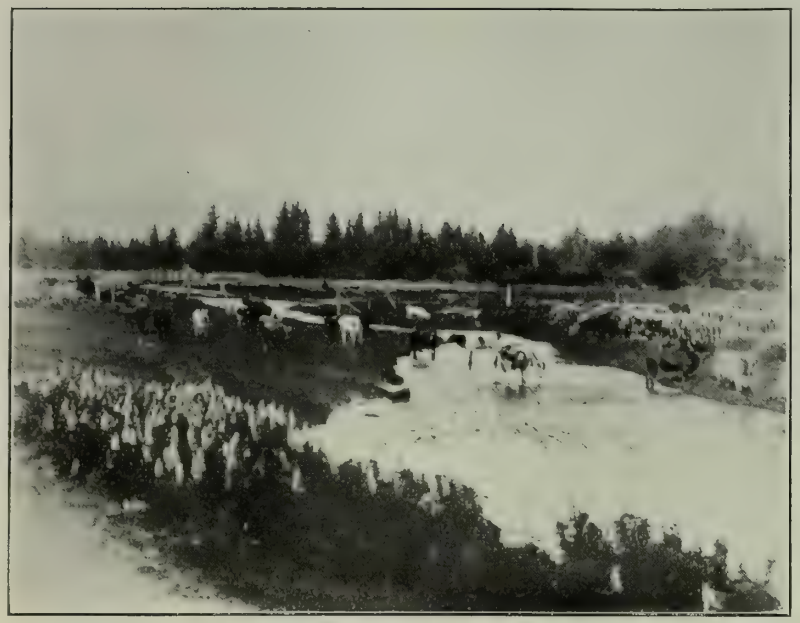
The encouragement of reindeer raising is one of the great constructive acts.

The timber of Alaska is a great asset.

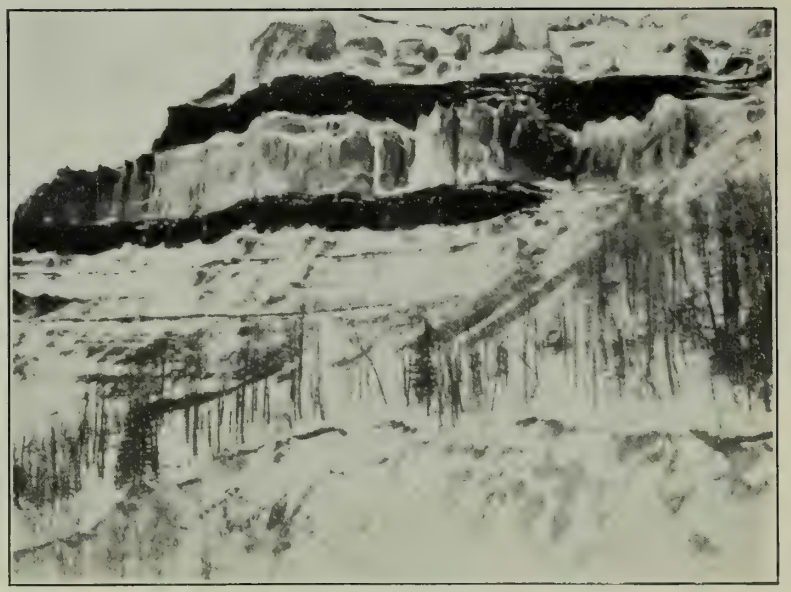
Emptying the nets of salmon.

Seward, Alaska, terminal of the new Government railroad.

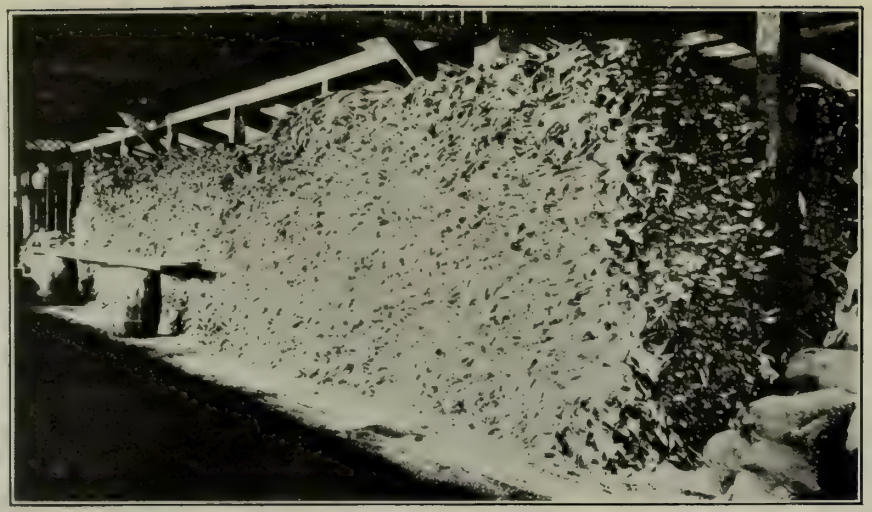
A fine truck farm near Fairbanks, Alaska.



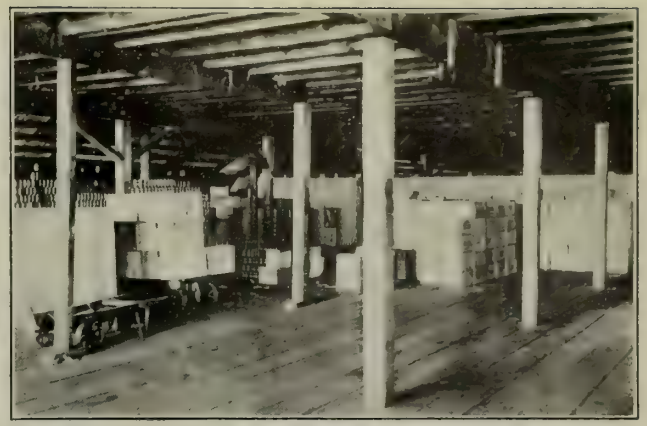
Dairy farm near Juneau, Alaska.



Rich coal deposits which should be utilized.



146,000 salted codfish.

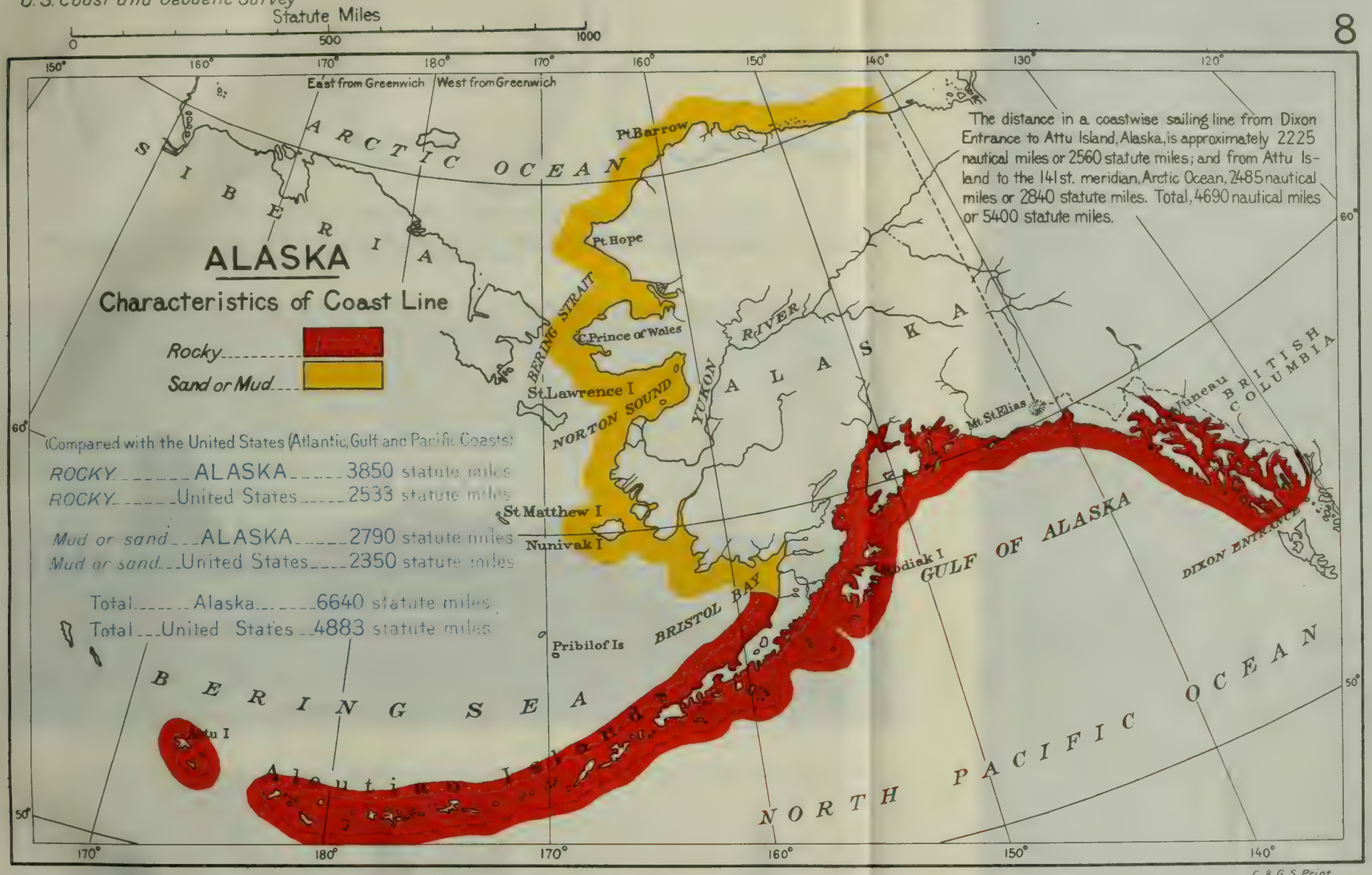


Cases of salmon ready for shipment.

Blue and white fox skins. Fur-bearing animal farms are profitable.

Hundreds of halibut in cold storage.

U.S. Coast and Geodetic Survey


Statute Miles
0
500
1000
East from Greenwich
West from Greenwich
ARCTIC OCEAN
SIBERIA
ALASKA
Characteristics of Coast Line
Rocky
Sand or Mud
Pt Barrow
Pt Hope
BERING STRAIT
C Prince of Wales
St Lawrence I
NORTON SOUND
YUKON RIVER
ALASKA
Mt St Elias
Juneau
BRITISH COLUMBIA
DIXON ENTRANCE
GULF OF ALASKA
St Matthew I
Nunivak I
Kodiak I
BRISTOL BAY
Pribilof Is
BERING SEA
Attu I
Aleutian Islands
NORTH PACIFIC OCEAN
The distance in a coastwise sailing line from Dixon Entrance to Attu Island, Alaska, is approximately 2225 nautical miles or 2560 statute miles; and from Attu Island to the 141st. meridian, Arctic Ocean, 2485 nautical miles or 2840 statute miles. Total, 4690 nautical miles or 5400 statute miles.
(Compared with the United States (Atlantic, Gulf and Pacific Coasts)
ROCKY ALASKA 3850 statute miles
ROCKY United States 2533 statute miles
Mud or sand ALASKA 2790 statute miles
Mud or sand United States 2350 statute miles
Total Alaska 6640 statute miles
Total United States 4883 statute miles
150° 160° 170° 180° 170° 160° 150° 140° 130° 120°
60° 50°
170° 180° 170° 160° 150° 140°

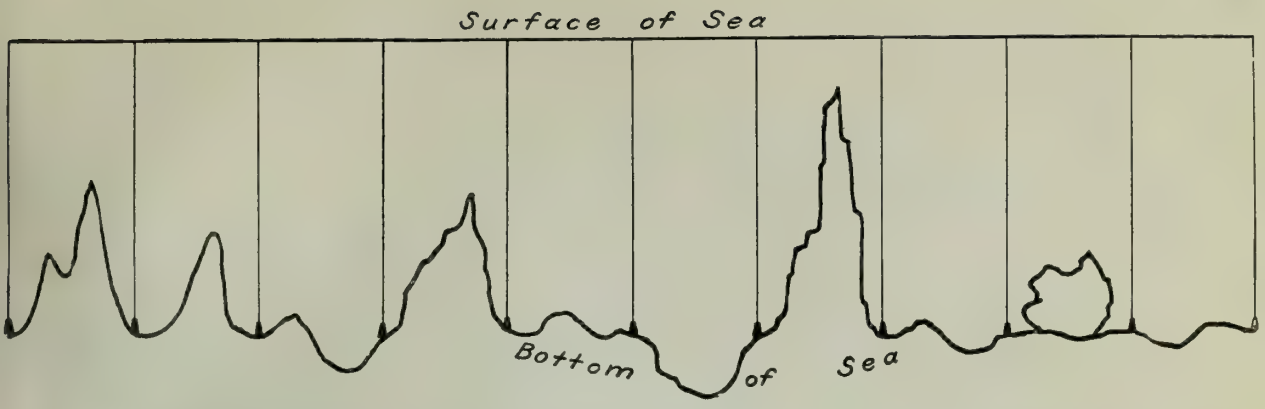
C & G S Print

The length of Coast Line as given above represents the General Coast Line measured in unit steps of 30 minutes of latitude (=35 statute miles).

With unit steps of 3 statute miles, the comparative lengths of tidal shoreline are as follows:

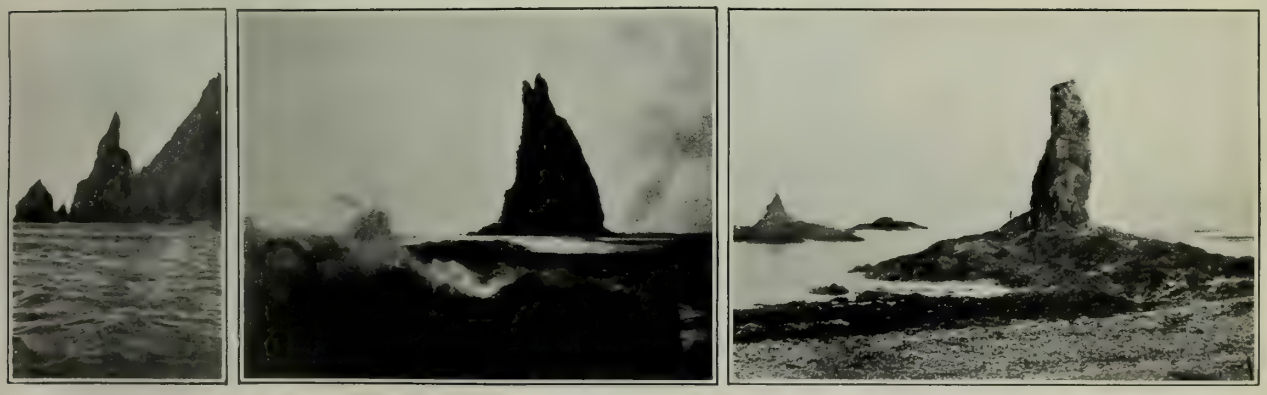
Alaska ..... 15,132 Statute miles
United States (Atlantic, Gulf and Pacific Coasts) ..... 12,877 Statute miles

The use of a smaller measuring unit gives 26,376 statute miles of shoreline for Alaska which, when the survey is completed, may be increased 40 per cent.



SKETCH SHOWING BOTTOM PROFILE FREQUENTLY ENCOUNTERED IN ALASKA WATERS.

The lead line is of little use in charting regions where the ocean bottom is of this character, for there is little chance that a lead thrown at regular intervals from a moving vessel will strike the summits of these pinnacle rocks. Even if the lead should strike such a pinnacle (pointed rock), it would be likely to glance off and record the greater depth at the base of the rock.



PINNACLE ROCKS.

Towering rocks of this character abound below the surface of Alaska's coasts and waterways. One of these rocks reaches a height of 494 feet.

CHAPTER I.—INTRODUCTORY.

GENERAL DESCRIPTION OF COAST.

The shores of Alaska, from the southernmost point at Dixon Entrance throughout southeastern, central, and western Alaska, along the northern Pacific coast side and the Bering Sea side of the Aleutian Islands and back along the Alaska Peninsula to the neighborhood of Bristol Bay, are exceedingly rocky, with stretches of sandy beach here and there. In rapidly reviewing the nature of the coast of Alaska, emphasis must be placed on the precipitous rocky shores of these parts of Alaska, which consist almost entirely of elevated islands and peninsulas carved by glacial action and separated by narrow and deep fiords. Here was found the inspiration for that term "pinnacle rock," which aptly describes the dangerous instrument so well designed by nature to effectually tear a hole in the bottom of a vessel and send her to the bottom. (See fig. 8.)

Passing through these waters, the traveler sees on every hand rugged mountain ranges whose profiles present a bewildering confusion of sharp, jagged peaks of various heights. Let him, then, imagine these same features duplicated in the waters under him, the top of the highest peaks appearing above the surface in the form of precipitous rocky islets, those of slightly less elevation rising to within a few feet of the surface, while others, still lower, rise but slightly above the bottom. (See fig. 9.)

With this picture in mind, we have some conception of what a problem it is for the hydrographic engineer to discover and chart these hidden dangers rising from the great depth of the ocean and waiting to rip open the bottom of the unfortunate ship that passes their way. To make matters worse, the navigator who can detect other dangers to his vessel with some accuracy is yet groping in the dark with no means of divining the presence of this hidden danger of the sea. There is no break in the water and no ripple on the surface above it. There is absolutely no indication of this hidden menace.

From Bristol Bay northward in Bering Sea and Arctic Ocean, to the one hundred and forty-first meridian, the northeastern point of Alaska, the coast line is generally composed of sand beaches and mud flats.

EXTENT OF THE GENERAL COAST LINES.

The lineal extent of each kind of coast line included under the classifications according to formation is given below. That a wrong impression may not be conveyed as to the magnitude of the hydrographic area requiring the attention of this Bureau, it is proper to say here that the lineal extent of these shores under these classifications only partly states the condition, for the very patent reason that much depends upon how quickly these shores drop off to great depths free from obstructions to navigation. If the water is comparatively shallow for great distances toward the sea, dotted with islands, a linear extent of a few miles of shore line embraces great areas to be surveyed, whereas if the shore drops off to great depths free from pinnacle rocks, the area necessary to be covered is comparatively small.

The linear extent of Alaskan general coast lines, classified according to formation, is as follows:

	Miles.
Rocky (generally fixed and unchanged by action of sea and currents), coast of Alaska from Dixon Entrance to Bristol Bay	3,850
Sandy (subject to change from action of sea and current), from Bristol Bay around the Alaskan coast to the one hundred and forty-first meridian	2,790

WEATHER CONDITIONS.

On the southern coast of Alaska, including the Aleutian Islands, seasons vary greatly, but in general the summer season, from about May to October, is the drier season, and the rains, though frequent, are local. Occasional gales from southeast to southwest occur, but they are usually less severe than in the fall and winter. From about November to April is the rainy season, and rains or snows are general and continue for extended periods with little interruption; gales increase in frequency and severity. The temperature on the outside coast is generally above freezing, but in the inlets reaching into the interior it is considerably lower.

Along the coast the weather in general is misty or rainy, with fog and frequent blows. It will usually be found that an on-shore wind brings misty weather and an offshore wind clearing weather. It will also be found that the weather noticeably improves as one proceeds toward the head of the various inlets. Thus, at the head of Prince William Sound, Cook Inlet, Nushagak Bay, or Kuskokwim Bay, bright clear weather will occur when there is wind and rain at the entrances.

The most striking feature about the weather in Bering Sea is its great uncertainty throughout the year. Good weather is rare and not lasting, and the winds can not be depended upon to remain long in one quarter. The late spring and summer are mild and very foggy, with frequent periods of light weather, comparatively few strong winds, and considerable rain. After the 1st of September gales become frequent and heavy, fogs gradually lessen, and toward the latter part of the month snow often accompanies the storms. During all the fall gales are frequent, violent, and from almost any quarter.

Winds.—The prevailing winds in summer are from southwest and northwest, the former during the early months and the latter during June, July, and August. In September and the early part of October the winds are uncertain, and there is generally much calm and heavily overcast weather. The usual winter winds are southeast or southwest, more frequently the former, accompanied by rains; they set in toward the end of October and continue until the middle of April. Southeast winds are invariably accompanied by mist or rain, and east and northeast winds usually bring snow. Southwest and northwest winds are clearing winds. On the coast in the northerly part of the Gulf of Alaska the prevailing winds during the summer are easterly with rain, the gales during that time being from the same direction.

Fog.—On the outside coast of British Columbia, southern Alaska, and Aleutian Islands, and in the inlets opening from the ocean, fog may occur at any time, but is most frequent in July, August, and September. During this season the fog usually comes after midnight and holds until the following noon, or later, unless previously dispelled by clearing winds or the drying effect of the sun. During the fall and winter fogs are more infrequent, but when they occur are likely to be of longer duration than those of summer. Continuous fogs, of varying densities, lasting 2 to 10 days, have been known. In the spring fogs are rare and of brief duration. Westerly winds are those which drive in sea fog; easterly and northerly winds are the usual clearing winds. Southeast winds also clear away the fog, but invariably bring mist or rain.

In Bering Sea fog is most prevalent during spring, summer, and early fall, and it generally begins to clear about the middle of October. In summer fog is almost continuous, but few days are clear from morning to night, and the tops of the mountains can seldom be seen. At the surface of the water it is generally sufficiently clear to make out the shore at a distance of 3 or 4 miles, but at times it is so thick that nothing can be made out. During the summer months the mist and fog are considered to be worse on the south side of the Aleutian Islands than on the north side in their immediate vicinity.

Ice.—Practically the entire southern coast of Alaska, including the Aleutian Islands, is free from ice the entire year. During very cold weather, ice sometimes forms in the inlets which reach well into the mountains, and at times is sufficiently heavy under exceptional conditions to impede navigation for wooden vessels for a few days.

Scattered ice is frequently found in places in southeast Alaska and the northerly and westerly sides of Prince William Sound, being discharged by the glaciers in those localities. This ice, however, would not interfere appreciably with surveying operations.

The upper part of Cook Inlet is more or less obstructed by heavy ice, which forms on the flats and in the shallower waters from December to April. The determining factor is the severity of the weather, which varies greatly from year to year. Ordinarily, however, no surveying operations could be done in Cook Inlet during the winter on account of the ice.

Bering Sea is ordinarily closed to navigation by ice from about October to June. In Bristol Bay, the southeasterly part of Bering Sea, navigation is open from about the first of June to the last of October, while in Norton Sound, the northerly part of Bering Sea, navigation is open from about the latter part of June to the first half of October.

In the Arctic Ocean heavy pack ice is always prevalent in the open sea, and navigation along the northerly coast of Alaska is possible only from about the middle of July until the middle of September.

MANY UNDEVELOPED HARBORS OF ALASKA.

Unlike the waters adjacent to the States bordering on the Pacific coast, Alaska has many fine harbors, and except a stretch beginning at Cross Sound in Southern Alaska and extending to Controller Bay, Prince William Sound, Central Alaska, a distance of 275 miles, where there is only one harbor of refuge for vessels (Yakutat Bay), over the many miles of Alaska's coasts nature has provided bountifully for ships and shipping in splendid harbors.

In this respect the south coast of Alaska resembles Norway and Sweden, her harbors being so numerous as to meet every demand for the future development of the entire Territory. In Bering Sea, northward and eastward of Unimak Pass, the harbors are not so plentiful and are characterized by shoals in the approaches. This makes it specially necessary that accurate surveys be made in order to permit safe navigation. It is remarkable how little accurate knowledge is available in connection with the many bays adjacent to the mainland, and more especially about the many islands of Alaska.

Not until these are properly safeguarded can it be hoped that they will be properly or permanently developed.

HISTORY OF SURVEYS.

Prior to about 1750 Russian America, now Alaska, was a blank on our maps. Beginning with Bering's first expedition, in 1725, dim and obscure outlines began to appear on this blank space. The exploration and mapping of Alaska by the Russians continued throughout the period of their occupation, which terminated in 1867.

Next to the Russians, the English explorers—Cook, Vancouver, and others—contributed most largely to our general information relative to the coasts of Alaska. In addition, however, some exploration work was done by Spaniards, Frenchmen, and by American whaling vessels. The earliest large contribution by the United States was made by the North Pacific Exploring Expedition of 1855.

In 1867, at the time of the cession of Alaska by Russia to the United States, the charts were a compilation from the work of these various explorers. No accurate surveys had been made by any of them, and their charts were more or less crude sketches, giving a general idea only of the configuration of the coast and harbors.

The work of the United States Coast and Geodetic Survey in Alaska was begun in 1867. Nearly every year from that date until 1880 one *small schooner*, and a shore party at times, were employed during the summer in determining latitude, longitude, and magnetics at various points throughout Alaska to fix approximately and tie together the positions of the various sketches of the early explorers. Some reconnoissance surveys of a number of harbors were also done by these parties.

The first comprehensive survey of Alaska was begun by the steamer *Hassler* in 1882. This work started at the southern boundary line of the principal inside route in southeast Alaska.

The steamer *Patterson* was built on the Atlantic coast for the Alaska work and her first season of surveying there was in 1885. Since that time this vessel has been employed every year, except 1898, during the surveying season in Alaska. The *Hassler* was employed in Alaska from 1892 to 1894 and the *McArthur* from 1886 to 1892, and otherwise the *Patterson* was the only surveying vessel employed in Alaska from 1885 to 1897.

The reason for this is not hard to seek. The surveys on the Pacific coast of the United States were begun in 1850, so that in 1867, when Alaska was purchased, the surveys of the Pacific coast were not advanced very far and were considered more urgent than the survey of Alaska, having in mind the comparatively small traffic to the Territory. Owing to the increased commercial activity caused by the rush to the gold fields in 1898, both by way of Lynn Canal and Bering Sea, the demands for surveys of Alaska became imperative.

The steamer *Patterson* was employed from 1899 to 1900 and the *Pathfinder* in 1900 in surveying Norton Sound and the approaches to the Yukon River, in order to furnish accurate charts that were imperatively needed by vessels, consequent on the increased traffic in the Yukon River and to the gold fields in the vicinity of Nome. These vessels were assisted by the small steamers *Taku* and *Yukon*, the parts of the latter of which were constructed in the United States and the vessel assembled at St. Michael, Alaska. The *Taku* and *Yukon* were light-draft vessels designed for surveying the shallow waters of the Yukon River delta.

In 1901 the *Pathfinder* surveyed the principal passes in the Aleutian Islands which are used by commercial vessels going to Nome and St. Michael. Sufficient work in these passes to make an accurate topographical survey of the islands and to show their relation to each other was completed, but the survey of the water areas was a reconnoissance only and this part of the surveys has never been completed. The *McArthur* assisted in these surveys.

In 1902 the *Patterson*, with the assistance of shore parties, determined by astronomical methods the location of the east end of St. Lawrence Island and the west end of Nunivak Island. From 1909 to 1913 the *Explorer* was employed in surveying the entrance to Nushagak River and Kuskokwim River, assisted in the latter survey by the steamer *Yukon* from 1914 to 1916. Other than as stated in this and the preceding paragraphs, no surveys have been made of the coast of Bering Sea.

Since 1898 practically the entire facilities of the Coast and Geodetic Survey on the Pacific coast of the United States have been employed in Alaska. As stated above, the *Taku* and *Yukon* were added in 1898. The *Gedney* was sent to Alaska in 1899, the *McArthur* in 1900, and the *Explorer* in 1907.

In 1905 the *McArthur* surveyed Resurrection Bay to meet the needs of commercial vessels carrying supplies for the railroad which was building from that point to Turnagain Arm. The following year the same vessel extended the triangulation from Resurrection Bay to Cook Inlet and the north end of the Kodiak Group.

From 1907 to 1911 the survey of Cook Inlet was completed. This was a commendable exception to the methods that the Coast and Geodetic Survey had through force of circumstances applied to other parts of Alaska. Ordinarily the surveys followed commercial development. In this case, however, there was but little commercial demand for the survey of Cook Inlet, but the survey was prosecuted vigorously to completion, having in mind the probability of early development. In 1912 and 1913 our Government began an investigation of the need for constructing railroads in Alaska, and the completed survey and accurate charts of Cook Inlet by the Coast and Geodetic Survey became a national asset.

In 1899 a shore party began the survey of Prince William Sound. The following year the small steamer *Taku* was assigned to this work and was continued in the survey of that important locality until the vessel was condemned and sold in 1917. Much of the survey of Prince William Sound has been done by this vessel.

In 1911, 1913, 1914, and 1915 the steamer *Patterson* was employed in surveys among the Shumagin Islands, south side of Alaska Peninsula. At the close of the season of 1915 the vessel was found to be structurally weak from age, and it was necessary to withdraw her from work in the exposed waters of southwestern Alaska. No other survey work has been done in that locality and further work will have to be deferred until a stanch vessel is available.

More survey work by the Coast and Geodetic Survey has been done on the coast of southeast Alaska than in any other similar large area in the Territory. One or more vessels have been employed there every year since 1882. Most of the early work was of a reconnoissance nature, as mentioned under "Inadequate surveys" in Chapter II.

From 1907 to 1915 was the period of greatest activity on the part of the vessels of the Coast and Geodetic Survey in surveying the coasts of Alaska. During these years there were available the *Patterson*, *Explorer*, *Gedney*, *McArthur*, and small steamers *Taku* and *Yukon*. At the close of the season of 1915 the *McArthur* and *Gedney* were condemned and sold on account of being unsafe for further work, and at the close of the season of 1917 the *Taku* was likewise condemned and sold. The *Surveyor* was completed in 1917 to replace one of these vessels, so that there are now on the Survey list of vessels the *Surveyor*, *Patterson*, *Explorer*, and small steamer *Yukon*.

In 1914 wire-drag work was begun in southeast Alaska by a single party, and from 1915 to 1917 two parties were employed. Notwithstanding the fact that the only vessels employed on this work were chartered makeshifts remodeled from fish boats, about 60 per cent of the main steamer route from Dixon Entrance to Skagway has been surveyed by this method.

A history of the survey of the coast of Alaska is not complete without mention of the very considerable additions to our knowledge furnished by officers of other Government bureaus. Officers of the United States Navy on naval vessels and vessels of the United States Fish Commission and officers of the vessels of the United States Coast Guard have made small surveys of some of the harbors from which charts have been prepared, and reports from these officers have added greatly to our information for insertion in the Coast Pilots for the use of mariners.

TOTAL COST OF ALASKA COAST SURVEY FOR 50 YEARS.

Years.	5-year period.	Annual average.	Years.	5-year period.	Annual average.
1867–1872	$40, 548. 53	$8, 109. 00	1898–1902	$610, 362. 22	$122, 072. 00
1873–1877	38, 479. 64	7, 695. 00	1903–1907	513, 239. 16	102, 647. 00
1878–1882	43, 289. 77	8, 657. 00	1908–1912	842, 434. 04	168, 486. 00
1883–1887	146, 228. 93	29, 245. 00	1913–1917	1, 154, 239. 26	230, 847. 00
1888–1892	281, 597. 42	56, 319. 00			
1893–1897	326, 487. 99	65, 297. 00	Total	3, 996, 906. 96	

SURVEYING VESSELS OF THE PAST.

The following is a brief description of the vessels which have been available to the Coast and Geodetic Survey for surveying the vast area of the coastal waters of Alaska. The need of modern vessels for the work is discussed in Chapter III.

Schooner "Humboldt."—Length 76 feet, beam 21 feet, and draft 5 feet. Built in 1855. Used in Alaska in 1871 and 1872.

Schooner "Yukon."—Length 84 feet, beam 22.2 feet, draft 9 feet, and tonnage 78. Built in 1873. Used in Alaska in 1873, 1874, and 1880. (See fig. 10.)

Steamer "Hassler."—An iron vessel of 243 net tons; length 152 feet, beam 24.6 feet, draft 12 feet. Built at Camden, N. J., in 1872. Used in Alaska from 1881 to 1883 and from 1892 to 1894. (See fig. 11.)

Steamer "Gedney."—A composite vessel of 174 net tons; length 140 feet, beam 23.8 feet, and draft 8.4 feet. Built at New York, N. Y., in 1875. Used in Alaska from 1899 to 1915, and was then condemned and sold. (See fig. 12.)

Steamer "McArthur."—A wooden vessel of 130 net tons; length 115 feet, beam 20 feet, draft 12 feet. Built at Mare Island, Cal., in 1876. Used in Alaska from 1886 to 1892 and from 1900 to 1915, and was then condemned and sold. (See fig. 13.)

Steamer "Patterson."—A wooden auxiliary steam barkentine of 719 tons displacement. 500 gross tons, and 453 net tons; registered length, 163 feet; breadth, 27.3 feet; draft, 14.2 feet; indicated horsepower, 215; speed steaming, 8 knots; coal capacity, 133 tons; complement, 12 officers and 49 men. Built at Brooklyn, N. Y., in 1882. She shows a condition normal to a ship 35 years old after severe service. Used in Alaska, from 1885 to 1917. (See fig. 14.)

Launch "Fuca."—A wooden steam vessel of about 20 net tons; length 50 feet, beam 12 feet, and draft 5 feet. Built at Seattle in 1882. Used in Alaska from 1892 to 1896.

Steamer "Cosmos."—A wooden vessel of 25 net tons; length 52.5 feet, beam 12 feet, draft 4 feet. Built at Mare Island, Cal., in 1887. Used in Alaska as a tender to the larger vessel from 1888 to 1917. (See fig. 15.)

Steamer "Taku."—A wooden vessel of 25 net tons; length 70.6 feet, beam 16.5 feet, draft 5.5 feet. Built at San Francisco, Cal., in 1898. Designed of light draft especially for the survey of the Yukon delta, used in Alaska from 1898 to 1917, and was then condemned and sold. (See fig. 16.)

Steamer "Yukon."—A composite steam vessel of 38 gross tons and 25 net tons; registered length, 75 feet; breadth, 15.7 feet; draft, 5 feet; indicated horsepower, 100; speed, 7.5 knots; coal capacity, 16 tons; complement, 4 officers and 13 men. Built at New York in 1898. Really a large launch. Of limited use. Taken down, shipped by freight to St. Michael, Alaska,

10

UNITED STATES COAST AND GEODETIC SURVEY SCHOONER "YUKON."

11

UNITED STATES COAST AND GEODETIC SURVEY STEAMER "HASSLER."

12

UNITED STATES COAST AND GEODETIC SURVEY STEAMER "GEDNEY."

13

UNITED STATES COAST AND GEODETIC SURVEY STEAMER "McARTHUR."

14

UNITED STATES COAST AND GEODETIC SURVEY STEAMER "PATTERSON."

15

UNITED STATES COAST AND GEODETIC SURVEY LAUNCH "COSMOS."

16

UNITED STATES COAST AND GEODETIC SURVEY STEAMER "TAKU."

17

UNITED STATES COAST AND GEODETIC SURVEY STEAMER "YUKON."

18

UNITED STATES COAST AND GEODETIC SURVEY STEAMER "PATHFINDER."

19

UNITED STATES COAST AND GEODETIC SURVEY STEAMER "EXPLORER."

UNITED STATES COAST AND GEODETIC SURVEY STEAMER "SURVEYOR."

and there reassembled. Designed of light draft, especially for the survey of the Yukon delta, and used in Alaska from 1898 to 1917. (See fig. 17.)

Steamer "Pathfinder."—A steel vessel of 690 gross tons; length 168 feet, beam 33.6 feet, draft 13 feet. Built at Elizabeth, N. J., in 1899. Used in Alaska in 1900 and 1901, and since used in the Philippine Islands. (See fig. 18.)

Steamer "Explorer."—A wooden steam vessel of 450 tons displacement, 335 gross tons, and 228 net tons; registered length, 135 feet; breadth, 27 feet; draft, 10 feet; indicated horsepower, 400; speed, 10.3 knots; coal capacity, 85 tons; complement, 7 officers and 40 men. Built at Wilmington, Del., in 1904. Used in Alaska from 1907 to 1917. (See fig. 19.)

Steamer "Surveyor."—Newly built and now temporarily in the Navy. (See fig. 20.)

46294°—18——2

CHAPTER II.—PRESENT CONDITIONS.

HOW LITTLE THE PRESENT CHARTS MEAN TO MARINERS.

An important difference between Alaska waters and those of the continental United States is that scarcely enough work has been done to let us know just how much must be done to complete the charts. It is estimated that *91 per cent* of the water areas of Alaska are unsurveyed or insufficiently surveyed. (See fig. 21.) The development of the country has far outstripped the progress of surveys, not only because of the few vessels and parties engaged in the work but because of the great length of coast over which the various activities are scattered and the intricate system of channels for so much of its extent.

In order to appreciate the need of rapidly extending the surveys of these waters, it should be clearly understood that Alaska's only connection with the rest of the world is by the water routes.

The Government railroad now being built and the other existing lines are not trunk lines in so far as connection with the continental United States and Canada are concerned. The trunk line is the waterway from various ports in Alaska to Puget Sound and other west coast ports. The Alaska railroads and local steamboat lines are feeders only. The industries, which include chiefly mining of gold and copper on an immense scale and of various other minerals to a less extent, fisheries, especially salmon canning, but also supplying halibut and other fish to the market, agriculture and grazing, now of minor importance but developing, are scattered everywhere, and connection with the principal ports is by boat. The principal towns are on good harbors suitably located with reference to the steamer routes and the more important mines and canneries, and any town that loses any of these advantages soon declines in importance. In practically all cases the canneries and mines along the shores are visited directly by steamers.

The amount of these natural resources ripe for exploitation has been so great and the prize they offered so tempting that transportation could not wait for the Government to make the way to them secure. It has gone ahead, finding its own path to each new field, suffering great losses in so doing, but content to suffer them because the returns were so immensely greater.

Southeastern Alaska.—The first and most obvious needs are to complete the wire-drag work, and to survey the approximately 50 per cent or more of the water areas which are unsurveyed or insufficiently surveyed. Large areas of these waters have been partially sounded so that only dragging is necessary to complete the hydrographic surveys.

This drag work should be taken up in the order of its importance, beginning with the main steamer route through the region and then taking up the various tributary waters leading to areas of commercial importance.

For some years past two parties have been actively engaged in dragging the main steamer route, and this work is now about 60 per cent complete.

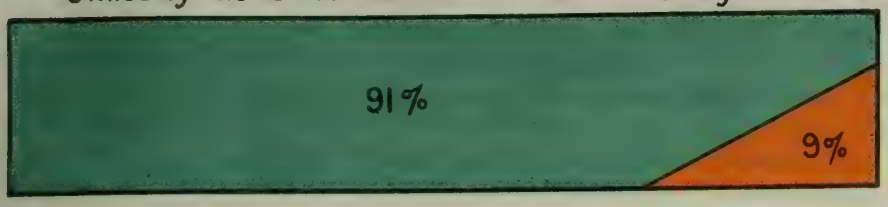
The outside coast of the islands bordering on the open Pacific and their connecting channels are largely unsurveyed or insufficiently surveyed, and have to be navigated with great caution.

Condition of water surveys, Coast of Alaska to 1917, as compared with the Philippine Islands

United States Coast and Geodetic Survey

Alaska

Owned by the United States since 1867 (50 years)



Green (91%) - represents unsurveyed water areas.
Salmon (9%) - represents water areas surveyed in past 31 years.

Two vessels of the Surveyor type will require 59 years to complete a first survey of the exposed Alaskan waters, in addition to the usual wire-drag and inshore parties necessary to survey the sheltered waters.

Now compare work done in the

Philippine Islands

Dependency of the United States since 1898 (19 years)

Green (36%) - represents unsurveyed water areas.
Salmon (64%) - represents water areas surveyed in past 17 years.

Philippine surveys have progressed more rapidly in 17 years than in the other regions shown on this sheet due to the funds and four (4) ships supplied by the Philippine Government.

C. & G. S. Print

A navigator seeing a chart on which the shore line is sketched, no soundings, several rocks and shoal banks, notes as to rocks and breakers reported, and a statement on the chart to the effect that the area is unsurveyed is, to say the least, unable to proceed with confidence; and this situation is by no means unusual. The most pressing need of such regions is a complete hydrographic survey, followed later in places by wire-drag work. The rapidly increasing commercial importance of this region and the exceptionally dangerous character of the waters through which traffic must pass render surveys in the near future imperative.

Cross Sound to Prince William Sound.—From Cross Sound, the northernmost channel from the inside waters to the sea, to Prince William Sound the coast has few features of present or prospective importance. There is, however, urgent need for surveys to insure the safety of vessels approaching and passing along this coast. This region is practically unsurveyed and the charts are very defective in the lack of soundings and prominent coastal mountain peaks and headlands that would enable the navigator to obtain his position on approaching from seaward. The only important break, or harbor of refuge, on this coast, Yakutat Bay, has been partially surveyed and complete surveys are urgently needed.

Prince William Sound to Unimak Pass.—A very important section of the Alaskan coast extends from the waters of Prince William Sound westward to Unimak Pass. The point to emphasize is that this is not an old settled country with its needs in the matter of transportation fixed, but it is capable of very great future development, and in considering the needed surveys this future must be taken into account.

The principal approaches to Prince William Sound and large parts of the sound itself have been surveyed. The greater part of the north and west shores of the sound, including Montague Island and Middleton Island, are unsurveyed. The dangers in Prince William Sound are true pinnacles which rise abruptly from great depths, differences of 50 fathoms (300 feet) in successive soundings obtained in the lead-line survey being not uncommon. Wire-drag work will be needed over large areas in this vicinity to insure safety to vessels.

Cordova is the terminus of the Copper River & Northwestern Railway, which gives access to the important copper mines on the Copper River. The approaches to Cordova have been surveyed except for wire-drag surveys needed to insure complete safety.

Seward, on Resurrection Bay, is the terminus of the Alaska railroad now being built by the Government. The surveys of its approach are completed except for wire-drag work.

It is probable that much of the freight originating along the line of the Government railway will be transshipped at Anchorage at the head of Cook Inlet. Not only will this make it necessary for many vessels to navigate these waters, but there are now large salmon canneries on its shores. This is one of the most promising parts of Alaska for probable agricultural development. A prominent feature of Cook Inlet is numerous bowlders, which are thickly scattered in places along its shores and in the inlet. The surveys are practically complete, but wire-drag work is needed over much of its area on account of the bowlders.

Kodiak Island, with a number of canneries and with some cattle grazing, is largely unsurveyed.

From Kodiak Island westward to Unimak Pass only a comparatively small part has been surveyed at all. While the amount of present traffic is small, it is sufficient to need protection. At present the Coast Guard vessels and the freight and passenger vessels are running grave risks in using the protected natural channel leading along the coast inside the islands. This is a particularly bad stretch of coast, with many reefs and islands. Only in the vicinity of the Shumagin Islands and from Sannak Islands to Unalaska Islands have any surveys been made,

and they are not complete. It is not now practicable to do drag work in this area, but it is certain that work of this character must be done eventually to insure the safety of vessels from Shelikof Strait to Unimak Pass.

Unimak Pass is the almost universally used channel into Bering Sea. It has been partially surveyed only, and additional hydrographic surveys are urgently needed. It is probable that part of it should be wire dragged.

Aleutian Islands.—The Aleutian Islands have comparatively little traffic and are without surveys. It is necessary that this region be patrolled by Coast Guard vessels. In the wreck of the *Tahoma* several years ago there was a loss to the Government equivalent to the cost of surveying a large part of this area. This is an excellent example of how, in a region of almost no traffic, the needed surveys cost little more than may be lost by the existence of a single uncharted reef.

Bristol Bay.—A large part of the red salmon shipped from Alaska comes from Bristol Bay. This is without survey except in Nushagak Bay and Kuskokwim Bay and River. Both of these have recent surveys, but as the bottom is subject to change on account of the large rivers, future additional surveys will be needed. As an example of what surveys mean in a new region, the discovery of an entrance to the Kuskokwim River suitable for moderate-draft vessels opened up an immense area suitable for grazing and also in places for general agriculture.

An exceedingly important industry is the raising of herds of reindeer.

Norton Sound.—Norton Sound is important for gold mining on its shores and at the mouth of the Yukon. The principal additional work required in Norton Sound is to keep track of the changes caused by the sea and currents. The approaches to Norton Sound through Bering Sea are unsurveyed. It is curious that in this sound, which according to all available information is of quite level sandy or muddy bottom, Besboro Island rises very abruptly to a height of 1,012 feet. With such an occurrence it is not absolutely certain that no pinnacle rocks exist.

Port Clarence.—Port Clarence, just south of Bering Strait, has canneries of some importance. While a survey of the port has been made, the approaches are unsurveyed.

Bering Sea and Arctic Ocean.—Except in the vicinity of Pribilof Islands, there are no other existing surveys in Bering Sea or the Artic Ocean which can be considered of sufficient accuracy to meet the needs of navigation.

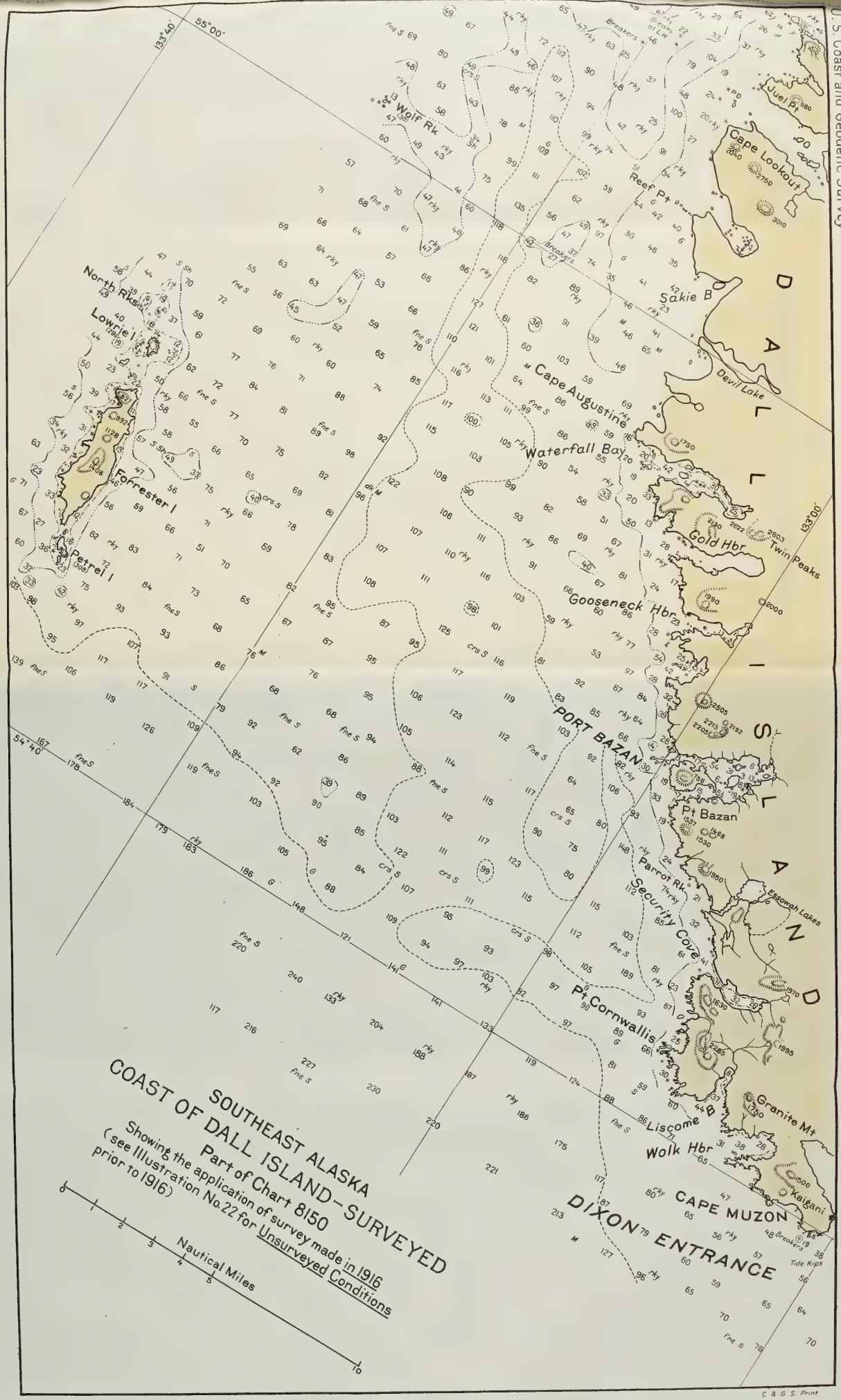
THE CAUSES OF WRECKS.

Under ordinary conditions losses of vessels are generally due to one of the four following reasons: Foundering, stranding, collision, and burning. Considering the first two of these reasons, the question arises To what extent would better surveys prevent such losses?

Founderings due to heavy seas may be prevented to some extent by surveys that develop protected inside routes along parts of the coast where vessels are now forced to take the open sea. Surveys will also develop harbors of refuge for vessels which can not now risk approaching an unsurveyed coast to seek shelter. Many Alaska harbors are now available only to vessels whose navigating officers have local knowledge, gained from long experience. (See figs. 22 and 23.)

Strandings can, in general, be classed under two headings—avoidable and unavoidable. The avoidable strandings, or strandings that may be prevented by proper precaution, such as frequent sounding, good lookout, steering correct courses, proper knowledge of the compass deviation, correct application of current data, etc., occur in well-surveyed regions, and the only safeguard to prevent this class of wrecks is greater care and caution on the part of mariners. (See figs. 24, 25, 26, 27, 28, and 29.)

DALL ISLAND
DIXON ENTRANCE
SOUTHEAST ALASKA
COAST OF DALL ISLAND-UNSURVEYED
Part of Chart 8150
as issued in 1917 before the 1916 survey was applied
(See Illustration No.23 for 1916 survey)
Nautical Miles
0 1 2 3 4 5 10
Cape Lookout
Sakar B.
Devil I.
Cape Augustine
Augustine B.
Waterfall Bay
Gold Hbr.
Goosneck Hbr.
Cape Magdalena
PORT BAZAN
Pt. Bazan
Parrot Rk.
Essowah Hbr.
Pt. Cornwallis
Lisoome Bay
Wolk Hbr.
Chickeman Bight
CAPE MUZON
Tide Rips
Wolf Rock
Reported rocks
Lowrie I.
Forrester I.
55°00'
54°40'
133°40'
133°00'
C&GS Print


SOUTHEAST ALASKA
COAST OF DALL ISLAND – SURVEYED
Part of Chart 8150
Showing the application of survey made in 1916
(see Illustration No. 22 for Unsurveyed Conditions
prior to 1916)
Nautical Miles
DALL ISLAND
PORT BAZAN
DIXON ENTRANCE
CAPE MUZON
Wolf Rk
Reef Pt
Cape Lookout
Juel Pt
Sakie B
Devil Lake
Cape Augustine
Waterfall Bay
Gold Hbr
Twin Peaks
Gooseneck Hbr
Pt Bazan
Parrot Rks
Security Cove
Essowah Lakes
Pt Cornwallis
Liscome
Wolk Hbr
Granite Mt
Kaigani
Tide Rips
North Rks
Lowrie I
Forrester I
Petrel I
55°00'
54°40'
133°40'
133°00'

C & G S. Print

40'
30'
136°20'
10'
58°
40'
2272
Miner I
16+
Junction I
Lake
Surge Bay
YAKOBI I.
LISIANSKI INLET
Takanis Bay
CAPE CROSS
Pt. Satchrun
Stag Bay
LISIANSKI STRAIT
58 fnebkS
CHICHAGOF ISLAND
Pt. Theodore
Pt. Parennes
Klin Bay
24 00
2800
3090
Porcupine Hbr
2000
1870
2070
Pt. Urey
Porcupine Is
Porcupine Elr. (26)
Pt. Dougherty
61 gnSG
75 gnSG
Pt. Weigle
Dry Pass
Goulding Hbr
Pinta Bay
Hill I.
84 gn whS
Imperial Passage
Hogan I
South Pass
100 fneG
FlWev 3 secs
936
Doolth Mt.
780
2120
530
480
490
300
CAPE EDWARD
Pakkan Bay
Klag Bay
Lake Arthur
DIXON PASSAGE
Numerous Reefs, Rocks and Islands
White Sisters
Black I
SOUTHEAST ALASKA
Region shown in this chart is unusually valuable
mineral resources.
Development cannot be made until surveys are
completed.
Part of chart 8250
C. & G. S. Print

REDFISH BAY
BARANOF ISLAND

Scale $\frac{1}{20000}$

From a survey by the U.S. Fish Commission in 1897

Latitude of Astro. Sta . . 56° 20′ N.
Longtude . . . . . 134° 52′ W.

C & G S Print

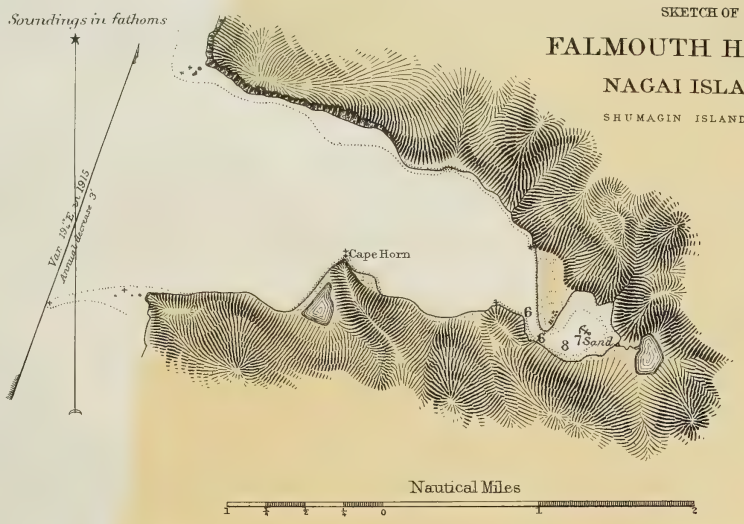
MONTAGUE ISLAND

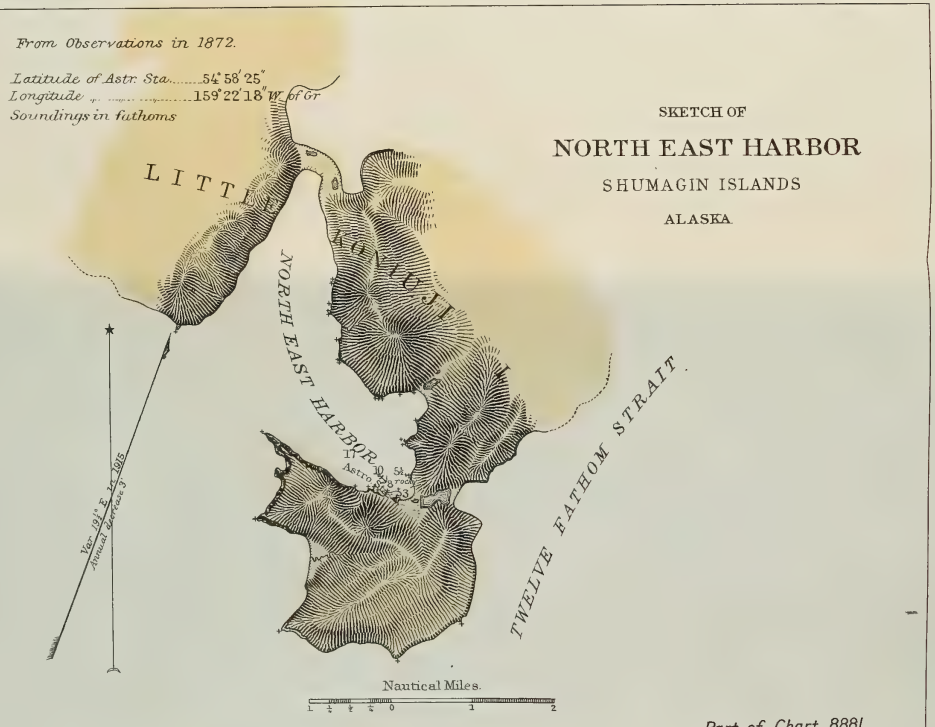
A large important island in Prince William Sound Entrance, Central Alaska. This is void of even a preliminary survey and the development of mineral and other resources is thus prevented.

PRELIMINARY CHART
PART OF MONTAGUE ISLAND
PRINCE WILLIAM SOUND ENTRANCE

(Part of Chart 8515)

C & G.S. Print





C. & G. S. Print

These Islands of Southwest Alaska are valuable for general farming as well as for fox farming.

The Navy has for a long time requested that certain portions be surveyed, but this has been impossible due to the fact that the Coast and Geodetic Survey has no available vessels.

ST. MATTHEW ISLAND

BERING SEA

From U. S. Surveys in 1874 and 1889

Latitude of Cape Upright 60°18' N
Longitude 172°04' W

An example of a large island in Bering Sea, which is almost without water surveys.
This island contains 54 square statute miles.
Hall " " 7 " " "
Total 61 " " "

Nautical Miles

PART OF CHART 8851

PART OF ALEUTIAN ISLANDS
AMCHITKA ISLAND TO ATTU ISLAND
A stretch of 300 nautical miles is almost entirely unsurveyed.
The loss of the Tahoma, as indicated in red, was directly due to the lack of surveys.
ALEUTIAN
ATTU I
NEAR ISLANDS
Cape Wrangell
NW Shoulder
Red Head
Holtz Bay
Discharge of Mbr (Chart 9196)
Sarana Bay
East Cape
Alaid I
Semichi Islands
Ingenstrem Pks
Buldir I
Sunken Rocks
1000 fathoms
Tide rips
Wreck of U.S.R.C. Tahoma, 1914
Tahoma Reef
McDonald Bay (Chart 8851)
Dog Cape
Nautical Miles
10 5 0 10 20 30 40 50
52°
176° E
RAT ISLANDS
Pillar Rk
Kiska I
Lake
Ferrier Pt
Haycock Rk
Tanadak Pass
South Pass
Twin Rks
Shoal water reported from south end of Kiska I. to Pat I.
Sealion Rk
Rat I
MacArthur Rk
Chugul I
Little Sitkin I
PETREL BANK
Semisopochnoi I
Sugarloaf Pk
AMCHITKA
Kirtlan Bay
Constantine Hbr (Chart 9196)
East Cape
Part of Chart 9102
C & G S Print

Unavoidable strandings are caused principally by a lack of surveys, such as when a vessel strikes an uncharted rock, or goes ashore while steering courses taken from an incorrect chart, or is set off the course by unknown currents. Good surveys are the only means by which this class of wrecks can be prevented.

From the records of the United States Steamboat-Inspection Service and other sources a table has been compiled of American vessels totally lost in Alaska during the 20 years from 1898 to 1917. This table is not complete and does not include the vessels that have been damaged but not totally lost, although the monetary loss in such cases, due to the cost of necessary repairs and the value of the time lost, is known to be great. This table includes 224 vessels, with a total tonnage of 87,243, a value of $10,659,950, and a loss of 280 lives.

The causes of the disasters given in the table are as follows: Total number lost, 224; lost by strandings, 156; foundered, 33; burned, 13; crushed by ice 3; unknown, 19.

Known strandings caused the loss of 156 of these vessels, or about 70 per cent of the recorded losses, and as Alaska is practically unsurveyed, most of these losses must be classed as unavoidable and could undoubtedly have been largely prevented by accurate surveys.

LOSS OF THE UNITED STATES REVENUE CUTTER "TAHOMA."

The following extracts from the report of the United States Revenue-Cutter Service (now the Coast Guard) for 1915 give details of the total loss of a fine vessel of that bureau of the United States on an uncharted reef in Alaska. (See fig. 29.)

On September 20, 1914, the *Tahoma*, attached to the Bering Sea Patrol Fleet, struck an uncharted reef in latitude 51° 53′ N., longitude 175° 53′ E., 31 miles S. 9° E. (true) from Buldir Island, one of the western islands of the Aleutian chain, and became a total loss. Having made a cruise along the northern coasts of the Aleutian Islands as far west as Attu in connection with the patrol duties, the cutter was returning east along the southern side of the group, and the course was set to pass 28 miles outside of and to the southward of the only two outlying dangers shown on the United States Coast and Geodetic Survey chart No. 9102. Suddenly, and without warning, at 9 p. m. of the above date, the *Tahoma* crashed upon a submerged reef. Every effort was made to save the vessel, but to no avail, and radio calls for assistance were sent out, giving the position of the vessel. Fortunately, considering the remoteness of the place where the cutter was wrecked, 670 miles west from Unalaska, the signals were heard by the radio station on St. Paul Island. The call was repeated to the fleet commander and at his request the Coast Survey steamer *Patterson* and the steam whaler *Kodiak* proceeded from Unalaska to the scene of the disaster. The steamer *Cordova*, southbound from Nome, was intercepted by radio and she at once changed her course and headed for the stranded cutter. In the meantime the wind and sea had risen, causing the *Tahoma* to pound so heavily upon the reef that the influx of water through the damaged bottom got beyond control of the pumps and extinguished the fires under the boilers. As the vessel settled in a pocket in the reef she took a dangerous list, and on the afternoon of the day following the disaster the commanding officer reluctantly gave the order to abandon the ship. This was accomplished in good order, and the seven ship's boats, provisioned and equipped, shaped courses for the nearest land to leeward, some 80 miles distant. Severe weather was experienced and the crews suffered considerably from exposure, but the boats were well handled and all save one succeeded in landing on Semichi and Agattu Islands, where rough camps were constructed and signal fires built to attract attention of the searching vessels.

On September 26 the crews of the three boats were taken from the islands by the *Cordova*, and a fourth boat picked up at sea 30 miles from the nearest land. On the 28th the crews of the three remaining boats were taken from the western end of Agattu Island by the *Patterson*, thus accounting for all hands on the ill-fated cutter.

A board was promptly convened by the fleet commander at Unalaska, and, after a searching inquiry into all the circumstances attending the disaster, found—

"That all necessary precautions were taken in the navigation of the *Tahoma* September 20, 1914, to avoid dangers known and marked 'position doubtful,' and that due care was exercised in carrying out the orders of the commanding officer; and further, that the loss of the *Tahoma* was not due to fault or negligence on the part of the commanding officer of that vessel, nor to any other officer or member of the crew of the said vessel."

It is believed that not a single island west of Unimak Pass is correctly charted; the positions of the islands themselves are incorrectly shown, the coast lines are incorrect, and the soundings and outlying dangers are, for the most part, left

to the conjecture of the navigator. These facts, together with the ever-present fog, make navigation in those waters a precarious undertaking, but it must be done. In performing the duty of enforcing the law and the treaty for the protection of the fur seal and sea otter, Coast Guard cutters are obliged to take many risks, and it is not surprising that the *Tahoma* struck an uncharted reef; indeed, the surprising thing is that the cutters have navigated those waters these many years with so few mishaps. (See figs. 30 and 31.)

INADEQUATE SURVEYS.

A typical case of the loss resulting from lack of surveys, or from trusting to incomplete ones, is found in the case of the steamer *State of California*, which on August 17, 1913, struck a submerged rock in Gambier Bay, Admiralty Island, and became a total loss, together with the loss of 31 lives. (See fig. 32.)

The charts of Gambier Bay were based on surveys made in 1889, when this was merely an unnamed and unused bay, no different from numerous others in southeastern Alaska. Due to this lack of importance, detailed surveys were not made; the work that was done was more in the nature of a reconnoissance, and the time thus saved was devoted to advancing the surveys of the important through routes.

Time passed, however, and with the growth of the salmon-canning industry a cannery was established in Gambier Bay, necessitating steamer communication.

Steamers had made numerous visits to the bay without mishap. The reason for their previous safety is, however, of itself a significant commentary on the conditions existing in Alaska. The masters of these vessels are so well aware of the inadequacy of the surveys of many of the waters they are compelled to traverse that they take extreme precautions to guard against accident. When they enter such an area for the first time, they carefully feel their way in, noting the track they follow. In all subsequent visits they carefully follow the same track, which they have thus proven safe on the stage of tide at which they entered. In this way, numerous visits were made to Gambier Bay without mishap.

On this last fatal occasion, however, a combination of circumstances resulted in disaster. The vessel had entered safely, taken cargo, and left the dock. At the time of her departure the tide was low. In passing out through the narrow entrance she deviated slightly from her usual course, a deviation probably no greater than she had made on numerous previous occasions. But this deviation, combined with the low tide, resulted in her striking a pinnacle rock. A large hole was torn in the ship's bottom without stopping her headway, and she passed over the rock into deep water, when she sank before she could be beached on the shore, only a few hundred yards distant. (See fig. 36.)

This survey of Gambier Bay is typical of much of the early work done in southeastern Alaska. It is but fair to add that it is as complete and detailed as was justified by the conditions existing at the time the survey was made. In those early days, when the Territory was largely undeveloped, the important work was the charting of the main steamer track through the archipelago. Gambier Bay, like many others, was merely an unknown, unimportant indentation, with no present traffic, and with the possibility of any future traffic highly problematical. Obviously, therefore, it would have been highly undesirable to utilize the limited equipment available for the longer period required to make detailed surveys, when such detail might never serve any useful purpose. Lacking facilities for making complete surveys with sufficient rapidity to keep up with the growth of the Territory, the Bureau had no alternative but to concentrate the work where it was most urgently needed, and to neglect for the time being those areas which were then unimportant.

30

UNITED STATES REVENUE CUTTER "TAHOMA," AUGUST, 1914.

31

UNITED STATES REVENUE CUTTER "TAHOMA," WRECKED SEPTEMBER, 1914.

32

STEAMER "STATE OF CALIFORNIA," WRECKED ON A PINNACLE ROCK, AUGUST, 1913. 31 LIVES LOST.

33

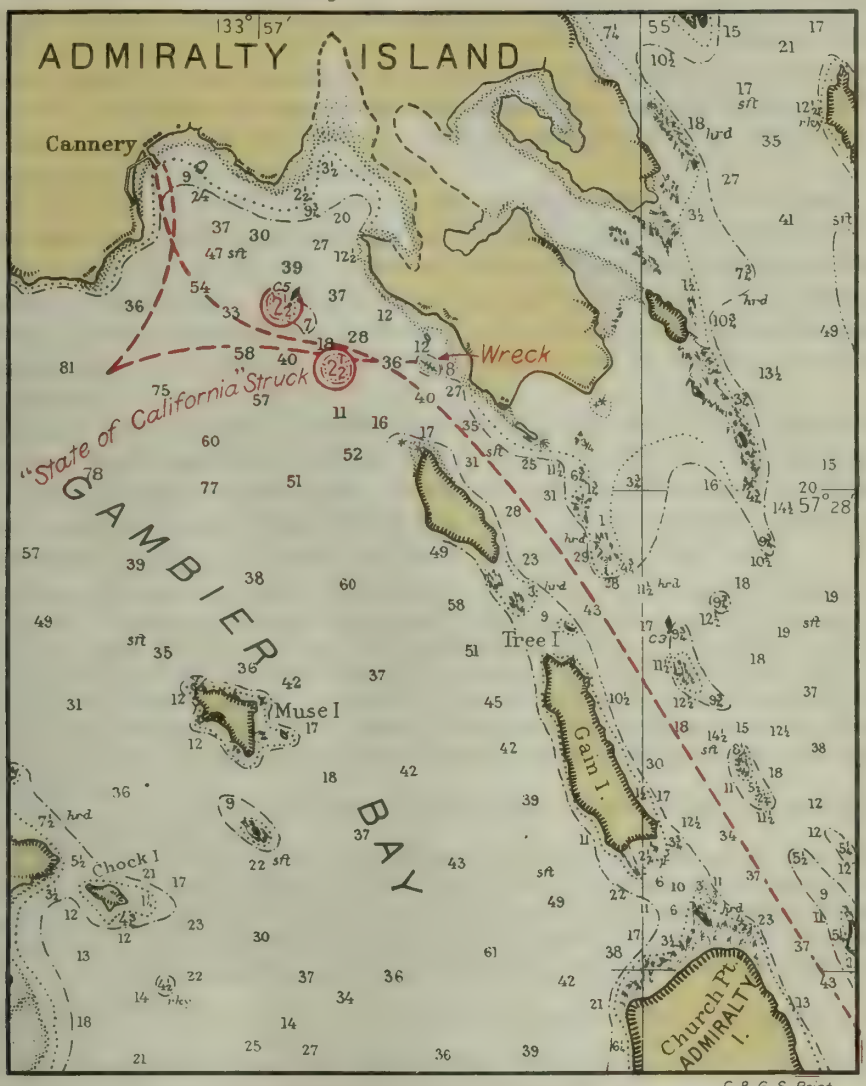
WRECK OF STEAMER "YUCATAN."

34

WRECK OF STEAMER "DELHI."

35

WRECK OF STEAMER "MARIPOSA," SUMNER STRAIT, ALASKA, NOVEMBER, 1917.



SOUTHEAST ALASKA

Soundings in fathoms (6 feet to fathom)

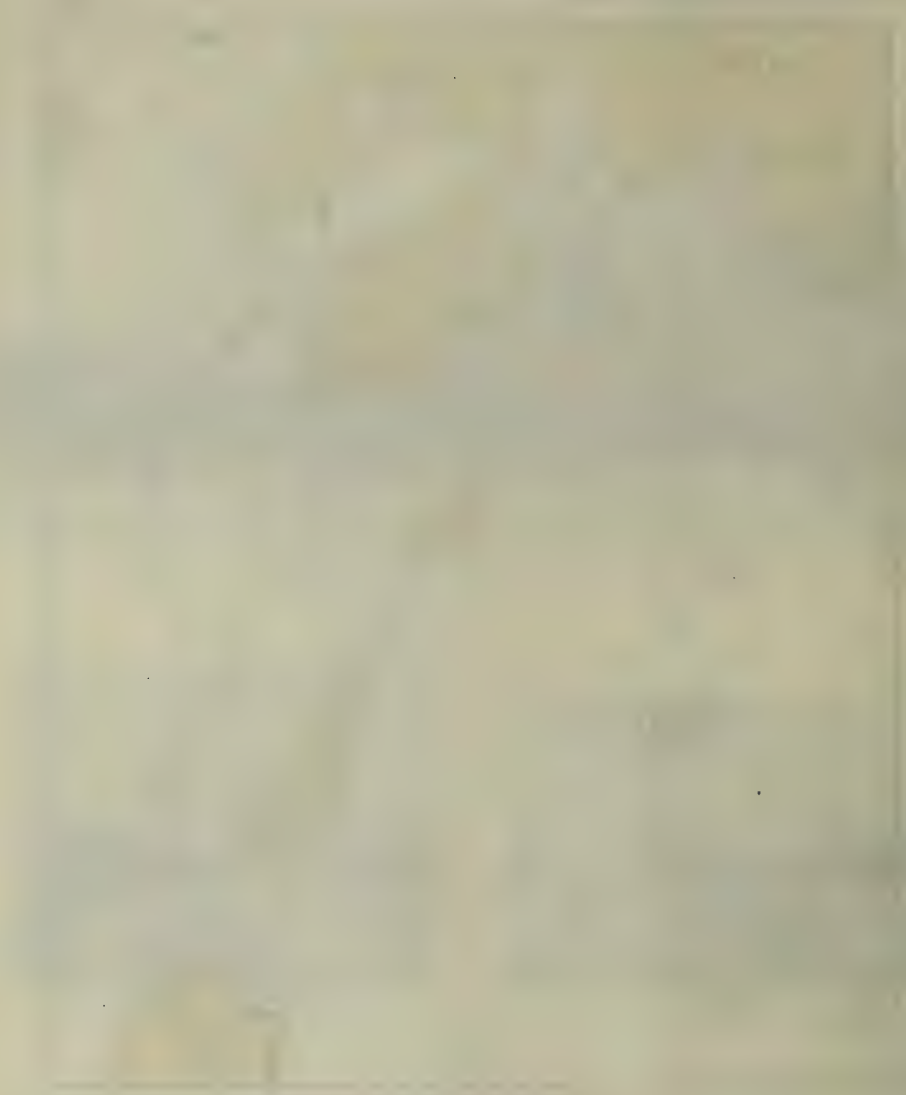
Soundings in red with circles represent pinnacle rocks located in 1913 at time STEAMER STATE OF CALIFORNIA was wrecked with loss of 31 lives.

Red dashed line shows course of vessel in approaching and leaving dock.

No evidence of these dangers was disclosed by first Hydrographic Survey. This shows the great need of Wire-Drag Surveys.

Nautical Miles

1 3/4 2 4 0 1



Now, however, we must squarely face the result of those early conditions. Everywhere throughout southeastern Alaska are small bays, similar in all respects to Gambier Bay—places where canneries or mines are in operation, and where, in consequence, steamers must call. Their surveys are as incomplete as were those of Gambier Bay, and the Coast and Geodetic Survey can yet offer no assurance that the fate which befell the *State of California* may not come to other vessels in any one of these localities.

Fortunately, the method of making surveys has recently been revolutionized. In those early days, when the only instrument available for this work was the lead, the most complete and detailed survey possible might have failed to reveal the presence of this pinnacle rock which sank the *State of California*. Within recent years, however, a method has been perfected by the use of which absolute assurance can be given that no unknown danger exists in any given area. This method consists in the use of the wire drag, which is described in Chapter III. (See figs. 33, 34, and 35.)

The following are extracts from a letter, dated October 27, 1916, from Capt. Jefferson F. Moser, United States Navy (retired), who was at the time vice president and general superintendent of the Alaska Packers' Association. While commanding officer of the United States Fish Commission steamer *Albatross* Capt. Moser had spent several seasons in Alaska, and made several small surveys in unsurveyed regions which he had visited in that vessel.

We have many complaints from our masters who are employed on our vessels operating in Bristol Bay in reference to the charts of that region. Excepting Nushagak Bay and the Kuskokwim, the surveys of which have more recently been published from your office, the charts of Bristol Bay appear totally inadequate for coasting navigation and are considerably in error. In fact the only charts of the locality referred to, No. 9302 "Bering Sea" and No. 8802 (old 8800) "Alaska Peninsula and Aleutian Islands" so far as they pertain to Bristol Bay and approaches are on the scale used for general sailing charts, and are of little use for coasting. We realize that the data even on these charts is largely compiled from old and antiquated Russian surveys, reconnoissances, and sketches, all obsolete so far as the needs of navigation are concerned.

From April to October no less than thirty-eight (38) deep-water sailing vessels and thirteen (13) ocean-going steamers and power boats enter and leave Bristol Bay.

In view of these facts, we would ask your early consideration for the survey of Bristol Bay and the approaches along the north side of the Alaska Peninsula from Unimak Island. We would suggest, if you deem it advisable, to commence this work on the land bordering Kvichak Bay in the vicinity of the mouth of Naknek Bay or River, off which the larger number of the sailing vessels find anchorage, and after the survey of Kvichak Bay is completed, to continue to Cape Grieg, which forms the approach to the northern entrance point to Ugashik, and which vessels bound for Naknek Anchorage strive to make.

We inclose herewith a copy of a letter addressed to the writer and signed by several of our masters on this subject.

The following are extracts from the letter, dated October 20, 1916, addressed to Capt. Moser and signed by 22 masters of vessels, trading to Bristol Bay:

We, the undersigned, beg to report that we found the charting of the land from Cape Grieg to Naknek Anchorage incorrect.

Middle Bluff is charted 7 miles north of its actual position, and soundings, shoals, and flats are very inaccurate from Port Moller to Bristol Bay, which caused the wreck of ship *Sintram* on Egegak Flats and the grounding of several other vessels.

We also wish to state that lights of small types on Point Protection, Middle Bluff, South Spit, and Cape Grieg would be of great assistance to navigation in Bering Sea, as strong irregular tides, calms, and fogs make it very difficult to navigate at times.

As a rule, all vessels make land at Cape Grieg.

We recommend that a survey be taken and a special chart drawn of Bristol Bay.

LOSS OF STEAMER "YUKON."

The following facts concerning the wreck of the steamer *Yukon* are given to illustrate a different phase of the survey problem in Alaska, not the danger of uncharted rocks, but the danger of unknown currents. (See fig. 37.)

At about 6 p. m. on June 11, 1913, the steamer *Yukon*, bound from the Kuskokwim River to Seattle, stranded in a fog on the northwest end of Sannak Island, south side of the Alaska Peninsula, and became a total loss. The facts later developed showed that the vessel, approaching Unimak Pass from northward in a fog, had made land the previous afternoon which was supposed to be Akun Head, on the southwest side of the northwestern entrance to the pass, but which was actually Ugamak Island, on the south side of the southeastern entrance to the pass. The vessel had, therefore, unknown to the master, been set entirely through Unimak Pass by the current. The master, assuming that he had made land on the northern side of the pass, shaped his course to lead through the pass and then to make Cape Pankof, 58 miles northeastward, sounding at frequent intervals; but, being 26 miles southeastward of his supposed position, he stranded on the reefs extending from the northwestern side of Sannak Island, and it was not until the following day that the master discovered his actual position. (See fig. 38.)

CURRENTS A BIG FACTOR IN NAVIGATION.

The following report relates to an experience of a vessel of the Coast and Geodetic Survey on a part of the track usually followed by vessels along the coast from southeast Alaska to Prince William Sound, Resurrection Bay, and Cook Inlet, the two last named being of especial importance as the coast terminals of the Government-owned railroad now under construction to the interior of Alaska.

On May 1, 1910, on a run of 13.5 hours from Ocean Cape to Cape St. Elias, with light easterly winds, the vessel, with a speed of 8.1 miles by log, was set about 28.5 miles in a 291° true (W. ¾ S. mag.) direction by the coast current, the average velocity of which was 2.1 miles per hour. In other words, due to this unknown current, the vessel was proceeding on a course northward of her supposed track at an actual speed of 10.2 miles per hour instead of 8.1 miles as shown by the log. Land was made at midnight in a drizzling rain on the eastern side of Kayak Island 7 miles northward of the projected course. Fortunately the weather was quiet and the surf breaking on the rocky coast was heard in sufficient time to prevent disaster. This experience shows the necessity for using caution in approaching Cape St. Elias from southeastward, as the prevailing northwesterly current will cause the vessel to be ahead of her reckoning.

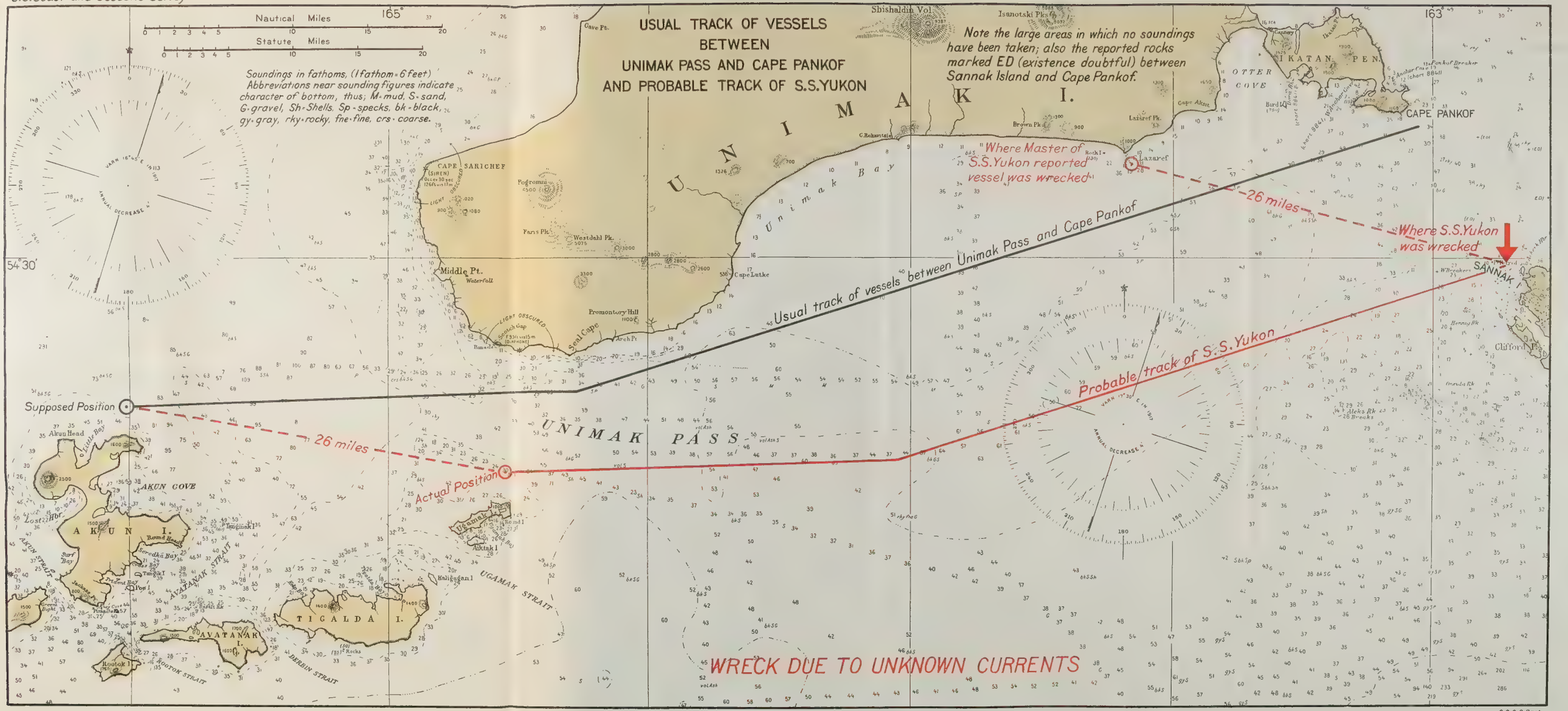
Similar experiences, although not so marked, are the rule rather than the exception in navigation, and show that accurate current data are essential to the safety of vessels.

Currents exist in all of the bays and passages and along the coast of Alaska, but as no systematic observations have been made, little is known about them and definite information is not available to enable navigators to allow for them and make their courses good.

Along the coast and in the more open waters, such as Bering Sea, there are currents which it is believed are due to meteorological conditions and which vary at different seasons. The following represents practically all we know about the coast currents, and is based on reports received from various sources and not on accurate observations:

A prevailing current sets northward and westward along the coast of British Columbia and Alaska. The distance it extends offshore is not known, but it is believed to be strongest near the coast and inside of the 100-fathom curve.

STEAMER "YUKON," WRECKED ON SANNAK ISLAND, JUNE 11, 1913.


USUAL TRACK OF VESSELS
BETWEEN
UNIMAK PASS AND CAPE PANKOF
AND PROBABLE TRACK OF S.S.YUKON
Nautical Miles
Statute Miles
Soundings in fathoms, (1 fathom = 6 feet)
Abbreviations near sounding figures indicate character of bottom, thus; M-mud, S-sand, G-gravel, Sh-Shells, Sp-specks, bk-black, gy-gray, rky-rocky, fne-fine, crs-coarse.
Note the large areas in which no soundings have been taken; also the reported rocks marked ED (existence doubtful) between Sannak Island and Cape Pankof.
Where Master of S.S.Yukon reported vessel was wrecked
26 miles
Where S.S.Yukon was wrecked
Usual track of vessels between Unimak Pass and Cape Pankof
Probable track of S.S.Yukon
Supposed Position
26 miles
Actual Position
WRECK DUE TO UNKNOWN CURRENTS
UNIMAK PASS
UNIMAK I.
CAPE PANKOF
SANNAK I.
AKUN I.
AKUN COVE
TIGALDA I.
AVATANAK I.
UGAMAK I.
AKTAK I.
IKATAN PEN.
OTTER COVE
CAPE SARICHEF
Middle Pt.
Cape Lutke
Promontory Hill
Seal Cape
Arch Pt.
Scotch Cap
Akun Head
Lazaref Pt.
Cape Aktak
Brown Pt.
Clifford Pt.
Shishaldin Vol.
Isanotski Pks.
Pogromni
Faris Pk.
Westdahl Pk.
54°30'
165°
163°

C.B.G.S Print

The estimated velocity of the current is 0 to 1½ knots, and is greatly affected by strong winds. In winter, with strong northerly and westerly winds prevailing in the Gulf of Alaska, it is probable that the current is stopped, and there may be a set in the reverse direction. No systematic observations have been made.

A constant set southwestward is reported along the east coast of Montague Island and south coast of Kenai Peninsula. A whaleboat lost off Wooded Islands was washed ashore on Cape Douglas and a spar lost off Point Gore was found on the northwest side of Sitkinak Island. The velocity is not known, but has been reported to be 1 knot or more at times.

It seems clear from all reports that the Japan current does not touch the shores of the Alaska Peninsula, and it is doubtful if it touches even the southern most of the Aleutian Islands. It is even disputed that this current is found at all this far eastward. No such warm water as that of the Gulf Stream is encountered, although a fairly definite stream of slightly warmer water can generally be found. This stream is well offshore and far out of sight of land; the current phenomena met with in the vicinity of the coast have no connection with it.

It is generally agreed that there is a continuous current of considerable strength following the coast all the way from Shelikof Strait to Unalaska Island.

This current searches out all the passages, large and small, between and around the many islands, and in some of them it becomes strong enough to be important. The tide has little effect upon it, for the tide sets generally on and off shore, while this current sets along the coast. For this reason a vessel generally finds it setting her ahead or back along the course and not to one side. An approaching northeast storm gives warning by strengthening this current; in many places the current will indicate northeast weather a day before the barometer falls. It may be that on some occasions this current turns in the other direction on its offshore side, near the 100-fathom curve, but this is not frequent, and there are no reports that it turns in the inshore part.

In the Aleutian Inland passages, as far as Attu, reports agree that the currents almost always flow into Bering Sea. There are many reports of strong currents in all the passages in this direction and almost none in the opposite direction. These currents are not to be regarded as branches of the Japan stream, for the water temperatures do not show a warm current; but it is agreed that they carry much small animal and plant life to the shores of the islands and into Bering Sea. Southward of the Aleutian Islands there is often a current toward them and toward all the passes; but farther off shore, well out of sight of land, the Japan stream is found setting eastward.

Along the northern side of the islands, on a line from Unalaska to Attu, it is agreed that the current sets eastward and is not influenced by tide. But in all this region and in Bering Sea the normal currents may be disturbed by bad weather and will then set with the wind or toward a low barometer; an abnormal current may often be a valuable storm warning. In all the Aleutian Islands the navigator must heed the currents carefully; a vessel is in more danger there from that cause than from any other, except the lack of surveys.

There has been no systematic study of the currents of Bering Sea, and the almost constant fogs prevent the navigator from adding much to our meager knowledge concerning them. It is said that in general the currents are greatly influenced by the tide and winds.

WHAT THE TOLL HAS BEEN IN WRECKS.

It is impossible to give an accurate list of the hundreds of vessels that have stranded, foundered, and been total wrecks in the waters of Alaska during the past 50 years. The records which have been somewhat neglected, especially in the earlier history of this comparatively

new possession of the United States, are anything but complete, but they are sufficiently known to convey to the minds of those who are interested a most harrowing condition that has existed during the last half century. While it should not be understood that all of these disasters have been caused by lack of proper sailing charts and lack of knowledge of currents, it can be said that the greater portion of the wrecks have been directly due to the lack of accurate nautical information which can be furnished by proper surveys.

Accidents to vessels in Alaskan waters have caused the loss of hundreds of lives and property to a value not far from twenty millions and which would represent to-day with the high cost of shipbuilding at least 50 per cent more. It will appeal to many as a matter of very poor economy that there is so little protection given to human life and vessel property employed in building up this truly great and remarkable empire of the United States.

From 1867 to 1917 there have been approximately 425 vessels wrecked in Alaskan waters, with a loss of about 500 lives. Among these vessels were large sailing crafts as well as freight and passenger vessels, also some Government vessels. When we stop to think for a moment of this enormous loss, and consider alone that the National Government has suffered the loss of three splendid vessels worth more than a million dollars, the serious side of the question is emphasized, especially when we think how much could have been done with this money if it had been applied in surveying the waters of Alaska. (See figs. 39, 40, 41, 42, and 29.)

WHY UNSURVEYED WATERS RETARD ALASKA'S DEVELOPMENT.

The history of the industrial development of Alaska shows that, almost without exception, the establishment of industries and commerce has preceded, rather than followed, the surveys of the locality and that their establishment and development have been greatly retarded and ofttimes entirely suspended by the lack of such surveys. The following cases are given to illustrate these conditions:

About 1910, deposits of excellent marble were discovered in Davidson Inlet, and a company was organized to quarry the rock and ship it to Seattle. However, as the approaches to the quarry were incompletely surveyed, the steamship companies refused to send their vessels there, and thus denied transportation, the marble company was helpless.

Finally, one of the steamship companies sent one of its pilots to the locality to report on the feasibility of sending in vessels in advance of complete surveys. The examination made by this pilot revealed so many uncharted dangers in the approaches that the company demanded a prohibitive price for permitting its vessels to enter.

The Coast and Geodetic Survey was appealed to, and in 1913 the Survey steamer *Explorer* made a detailed survey of the harbor and its approaches. The results of this survey, while confirming the dangers previously reported by the pilot, developed a practical channel through them, with the result that large quantities of marble are now being shipped annually to Seattle.

In 1905 an outcropping vein of gold-bearing quartz was discovered in Khaz Bay, on the west coast of Chichagof Island. Development work, begun immediately, showed the claim to be a rich one; portions of the uncovered vein showed nuggets and wires of free gold, and assays made of certain choice samples showed the gold contents running as high as $2,200 per ton of ore.

Yet, rich as was the vein, the owners were helpless to profit from it. The mine was at the head of a small bay which, with the waters leading to it, was unsurveyed, but known to be foul and dangerous; vessels passing along the coast could see large areas of reefs with jagged rocks showing above the surface. Therefore, the steamship companies refused to send in their vessels, to bring in mining machinery, or to carry out ore, except at a prohibitive cost.

The following illustrations Nos. 40, 41, and 42

STRANDINGS AND WRECKS OF VESSELS in ALASKA

(not including interior waters)

1900 to 1917 inclusive

205 VESSELS LOST

of which

116 VESSELS

(shown in red on illustrations Nos. 40, 41, 42)

Aggregating over 70,000 tons

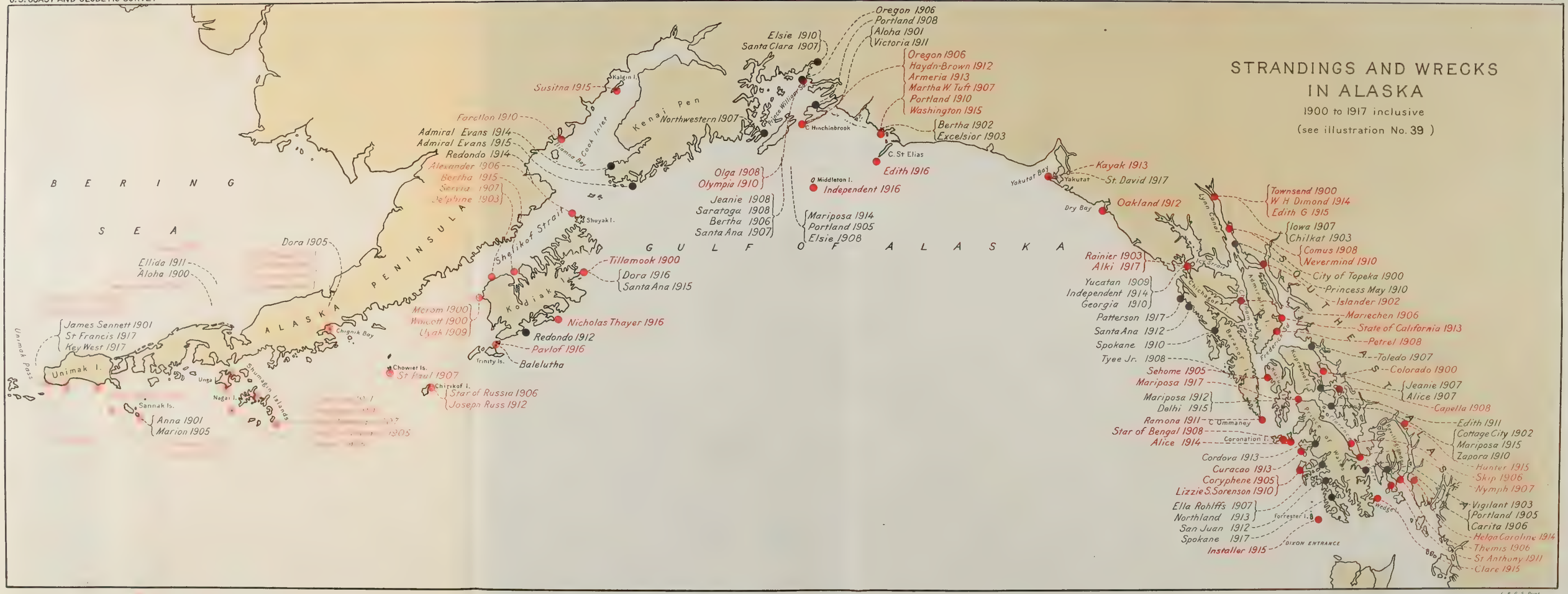
Valued at $8,600,000

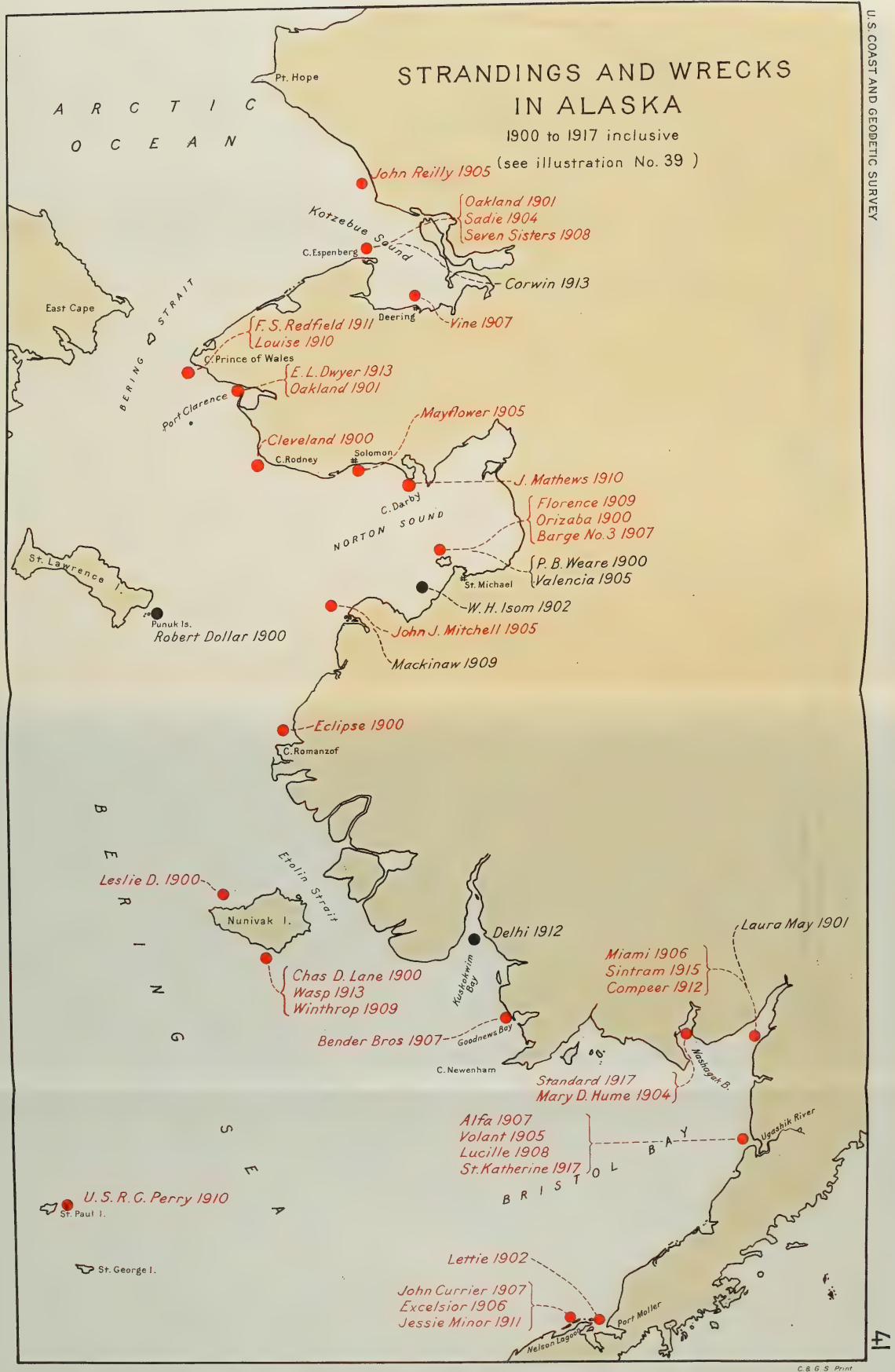
With 205 lives.

were losses to which the lack of surveys, the lack of accurate charts and the lack of information relating to the currents were contributing causes.

In addition to the above, from 1867 to 1899 inclusive, there were about 109 vessels stranded or wrecked in Alaska

C & G S Print


STRANDINGS AND WRECKS
IN ALASKA
1900 to 1917 inclusive
(see illustration No. 39)
B E R I N G
S E A
G U L F O F A L A S K A
ALASKA PENINSULA
Kenai pen
Kodiak
Unimak I.
Unimak Pass
Unga
Shumagin Islands
Nagai I.
Sannak Is.
Chignik Bay
Shelikof Strait
Kalgin I.
Nuka Bay
Resurrection Bay
Kings Bay
Prince William Sd.
C Hinchinbrook
C. St Elias
Middleton I.
Yakutat Bay
Yakutat
Dry Bay
Lynn Canal
Icy Strait
Chichagof I.
Admiralty I.
Baranof I.
Frederick Sd.
Chatham Strait
Kupreanof I.
Sumner Strait
Clarence Strait
Revillagigedo I.
Behm Canal
Tongass Narrows
Forrester I.
Dixon Entrance
Trinity Is.
Chowiet Is.
Chirikof I.
Susitna 1915
Farallon 1910
Admiral Evans 1914
Admiral Evans 1915
Redondo 1914
Alexander 1906
Bertha 1915
Servia 1907
Delphine 1903
Dora 1905
Ellida 1911
Aloha 1900
James Sennett 1901
St Francis 1917
Key West 1917
Merom 1900
Wancott 1900
Uyak 1909
St Paul 1907
Star of Russia 1906
Joseph Russ 1912
Anna 1901
Marion 1905
Tillamook 1900
Dora 1916
Santa Ana 1915
Nicholas Thayer 1916
Redondo 1912
Pavlof 1916
Baletutha
Elsie 1910
Santa Clara 1907
Oregon 1906
Portland 1908
Aloha 1901
Victoria 1911
Oregon 1906
Haydn-Brown 1912
Armeria 1913
Martha W. Tuft 1907
Portland 1910
Washington 1915
Northwestern 1907
Bertha 1902
Excelsior 1903
Edith 1916
Olga 1908
Olympia 1910
Jeanie 1908
Saratoga 1908
Bertha 1906
Santa Ana 1907
Mariposa 1914
Portland 1905
Elsie 1908
Independent 1916
Kayak 1913
St. David 1917
Oakland 1912
Rainier 1903
Alki 1917
Yucatan 1909
Independent 1914
Georgia 1910
Patterson 1917
Santa Ana 1912
Spokane 1910
Tyee Jr. 1908
Sehome 1905
Mariposa 1917
Mariposa 1912
Delhi 1915
Ramona 1911
Star of Bengal 1908
Alice 1914
Cordova 1913
Curacao 1913
Coryphene 1905
Lizzie S. Sorenson 1910
Ella Rohlffs 1907
Northland 1913
San Juan 1912
Spokane 1917
Installer 1915
Townsend 1900
W H Dimond 1914
Edith G 1915
Iowa 1907
Chilkat 1903
Comus 1908
Nevermind 1910
City of Topeka 1900
Princess May 1910
Islander 1902
Mariechen 1906
State of California 1913
Petrel 1908
Toledo 1907
Colorado 1900
Jeanie 1907
Alice 1907
Capella 1908
Edith 1911
Cottage City 1902
Mariposa 1915
Zapora 1910
Hunter 1915
Skip 1906
Nymph 1907
Vigilant 1903
Portland 1905
Carita 1906
Helga Caroline 1914
Themis 1906
St Anthony 1911
Clare 1915


STRANDINGS AND WRECKS
IN ALASKA
1900 to 1917 inclusive
(see illustration No. 39)
ARCTIC OCEAN
Pt. Hope
John Reilly 1905
Oakland 1901
Sadie 1904
Seven Sisters 1908
Kotzebue Sound
C. Espenberg
Corwin 1913
Deering
Vine 1907
East Cape
BERING STRAIT
F. S. Redfield 1911
Louise 1910
C. Prince of Wales
E. L. Dwyer 1913
Oakland 1901
Port Clarence
Mayflower 1905
Cleveland 1900
C. Rodney
Solomon
J. Mathews 1910
C. Darby
NORTON SOUND
Florence 1909
Orizaba 1900
Barge No. 3 1907
P. B. Weare 1900
Valencia 1905
St. Michael
St. Lawrence I.
W. H. Isom 1902
Punuk Is.
Robert Dollar 1900
John J. Mitchell 1905
Mackinaw 1909
Eclipse 1900
C. Romanzof
BERING SEA
Etolin Strait
Leslie D. 1900
Nunivak I.
Delhi 1912
Laura May 1901
Miami 1906
Sintram 1915
Compeer 1912
Kuskokwim Bay
Chas D. Lane 1900
Wasp 1913
Winthrop 1909
Bender Bros 1907
Goodnews Bay
C. Newenham
Standard 1917
Mary D. Hume 1904
Alfa 1907
Volant 1905
Lucille 1908
St. Katherine 1917
BRISTOL BAY
Ugashik River
U. S. R. C. Perry 1910
St. Paul I.
St. George I.
Lettie 1902
John Currier 1907
Excelsior 1906
Jessie Minor 1911
Port Moller
Nelson Lagoon

C.& G.S. Print

STRANDINGS AND WRECKS IN ALASKA

1900 to 1917 inclusive

(see illustration No. 39)

C.&G.S. Print

Here, also, the Coast and Geodetic Survey came to the rescue. In 1906 these waters were surveyed, and through channels thus made known, traffic to and from the mine was at once established.

About 1909 the valley of the Kuskokwin River began to attract considerable interest. Gold-bearing gravels were found in a number of localities, resulting in considerable placer mining on a small scale. The influx of prospectors and traders led to a demand for transportation to supply their needs. Such transportation was rendered practically impossible, however, in advance of surveys, by the character of the waters at the mouth of the river. Flowing through a soft alluvial soil, the river had formed a huge delta, consisting of long parallel ridges of submerged sand banks too shoal for vessels to cross, and separated by narrow channels of deep water. Of these channels, however, only two actually lead into the river; the remainder are merely blind sloughs which, as the river mouth is approached, finally become shoal and disappear.

The land at the mouth of the river is low and flat, and the entrance channels are so fa from shore that from a vessel in the channel only the distant mountains in the interior can be seen, even under the most favorable conditions. These mountains are usually obscured by the misty or rainy weather, which is characteristic of Bering Sea during most of the year.

Thus the problem confronting the navigator attempting to enter the river from seaward was an extremely difficult one. Lacking both surveys and aids to navigation, he was compelled to proceed blindly. The only method available to him was to keep going and trust to luck. If the channel he was in finally became too shoal for navigation, he would, if the draft of his vessel permitted, wait for high tide and then cross the intervening shoal to the next channel, or else turn back seaward and, rounding the shoal, enter the next channel and try his luck with that one, continuing this procedure until the right channel was found or else give up in despair and turn back. It was decidedly exceptional, and purely accidental, if a vessel managed to enter the river without serious delays or grounding; and in several cases the attempt was abandoned and the vessel turned back, carrying away the stores so urgently needed at their destination.

In one case a vessel, having reached the mouth of the river, spent four days trying a different channel each day, and most of the time aground, and finally gave up in despair. On another occasion a vessel, carrying passengers and their outfit bound for Bethel, unable to find her way into the river, turned back. The passengers, given their choice between being landed on the beach or being carried back to Seattle, chose the former, and were put ashore at Cape Newenham, 150 miles from their destination. It is presumed that they finally reached Bethel overland, for to men of their caliber such hardships are all a part of the day's work, but the experience must have been one to daunt men less accustomed to hardship.

In 1914 the Coast and Geodetic Survey completed a partial survey of the lower river and its approaches, in sufficient detail, however, to clearly define the entrance channels. The resultant charts did not render the navigation simple or easy—no survey could do that in waters of this character—but they did make it possible, by careful navigation, to find the way into the river without serious inconvenience. Showing what these surveys actually accomplished, it may be stated that in 1915 one of the Survey officers, unacquainted with this region and using only methods and data available to all navigators, safely piloted a vessel through the approaches and into the river without delay or inconvenience.

The following item is quoted from the Seattle Daily Times of August 24, 1914:

After an inspection trip over the west coast of Prince of Wales Island, southeastern Alaska, Superintendent R. R. Pierson, of the Alaska Steamship Co., has returned to his desk in Pier 2. He expresses himself as much impressed with the dangers of navigation in those poorly charted waters and averse to further risking any of the steel-bottomed vessels of his fleet in west coast service.

Pierson had never been to many of the little cannery ports that have grown up within the last two years and made this district one of the most productive in the north. The Pacific Coast Steamship Co. lost the steamship *Curacao* on a run to the west coast, and the Alaska Steamship Co.'s steamship *Cordova* was badly damaged by striking an uncharted rock on the same route. Two wooden-hulled vessels, the *Delhi* and the *Santa Ana*, respectively, are now the only craft sent to this section by the Pacific Coast and Alaska Steamship Co. (See fig. 34.)

The above cases illustrate a very serious condition with which the Survey has had to contend. In order to efficiently prosecute the surveys of so extensive a region as Alaska, it should be possible to lay down a definite scheme of operations for the surveys as a whole, and at the same time take care of the demands for special surveys in individual localities necessitated by industrial development. To do this, however, requires a much larger equipment than the Survey has ever possessed, and the result has been to dissipate its energy here and there in the attempt to meet urgent local needs such as have just been described. In other words, the Survey, instead of being the pioneer, going ahead to make safe the routes for commerce to follow, has been unable to keep pace with the rapidly increasing demands of commerce, and has struggled along ineffectually in the rear, falling ever farther and farther behind.

The result of this slow progress of surveys, due to lack of adequate equipment, has been a serious retardation in the development of many parts of the Territory, due to entire absence of transportation or to excessive freight rates.

Another way in which the lack of surveys retards Alaska's development is shown in the increased insurance rates between the United States and Alaska ports, as compared with rates of the same class between routes in surveyed waters.

The following is an extract from Leslie's Illustrated Weekly of December 28, 1911, in an article headed "Alaska's awful shipwreck curse":

H. F. Alexander, president of the Alaska Pacific Steamship Co., tells us that * * * insurance on vessels to Alaska runs all the way from 15 to 20 per cent, and even at these figures it is impossible to get complete insurance. As a contrast to this charge, Mr. Alexander advises us that the usual insurance rate on the Pacific coast is 6 to 7 per cent. He adds that the Alaskan insurance rate is almost prohibitory and results frequently in owners having to carry their own insurance.

In 1917, the insurance rates on vessels to Alaska by the inside passage were stated to be from 11 to 15 per cent, the reduction since 1911 probably being due to the fact that a part of the inside passage has been examined by means of a wire drag and the dangers charted. It has also been stated that the insurance companies feel less apprehensive in insuring vessels in the Alaska trade for larger amounts than formerly, due to the wire-drag surveys. The rates on the Atlantic coast vary from 3 to 5 per cent.

The insurance rates on general cargo between Seattle and Nushagak, Alaska, 2,100 miles, vary from 1½ to 2 per cent, while the rates on general cargo between New York and Galveston, Tex., 1,890 miles, vary from $^1/_5$ to ⅓ per cent.

CHAPTER III.—LOOKING INTO THE FUTURE.

COMPLETE SURVEYS NEEDED.

Because of the rapidly increasing commercial importance of Alaska, it is imperative that the present conditions as regards survey work be remedied by means of complete surveys, carried on in a systematic manner and extended with all possible rapidity.

In order to appreciate the immediate need for this work it must be clearly understood that Alaska's only connection with the rest of the world is by water routes. The millions of dollars that are being expended to build the Government-owned railroad to the interior of Alaska; the large amount of private capital that has been and will be spent to develop her mines, to build up her fishing industry; the certain early opening of the vast coal fields; the utilizing of the great timber resources, etc.; all this would be wasted and her vast resources would be worthless if vessels could not reach and enter her ports or visit the railroad terminals, canneries, and nearest ports as outlets to the many mines.

And it is a fact that, at the present time, there are few passages that can be navigated and few harbors that can be entered by a vessel with the assurance that the near-by shoreline and landmarks and the contour of the bottom over which she is traveling are accurately shown on the charts, or that the hidden dangers that may lie in her path have all been discovered and charted.

That, in the past, instead of blazing the trail for water-borne commerce, the Coast and Geodetic Survey, because of lack of funds and essential equipment, has been forced to lag far behind is as deplorable as it has been unavoidable. The time has now come, however, when we must face the issue squarely and realize that the interests of commerce, passengers, shipowners, navigators, and those who have invested their capital in Alaska's industries must be safeguarded by adequate surveys prosecuted vigorously and on a much larger scale than heretofore. And even then it will take years before the surveys can reach a point where they can meet the present needs of commerce. And it must not be overlooked that the time is not far off when our naval vessels will frequent Alaska's waters in numbers.

Scarcely enough work has been done up to the present time to give us an accurate idea of the amount of survey work that will be required. The following, however, may be taken as a general statement of conditions along this line.

In southeastern Alaska the first and most obvious need is to complete the surveys and wire-drag work. The larger part of these waters have been fairly well sounded, so that only dragging is necessary to complete the survey. The importance of wire-drag work in this locality and in other parts of Alaska will be discussed under a separate heading.

In all other regions only scattered surveys have been made. Complete hydrographic and topographic surveys must be made of all passages, bays, and harbors. In practically every case this work must be supplemented by wire-drag surveys, and many localities in which the ordinary hydrographic surveys have already been completed must be dragged.

On the outer coasts soundings must be extended for a sufficient distance offshore to enable the navigator to determine the distance of his vessel from land in thick weather by use of the lead; and to fully develop the great fishing banks, which are among the most extensive in the world. On the outer coasts wire-drag surveys will be required only at critical points and in the approaches and entrances to the numerous sounds and passages.

STUDY OF CURRENTS IMPORTANT.

The importance to the navigator of a definite knowledge of the currents that may to a considerable extent affect the course and speed of his ship has already been explained. Meager as our knowledge of the specific action of currents in Alaska may be, our general knowledge is sufficient to show that currents of very considerable strength are present in practically all of its navigable waters, and that the safety of vessels in places may be endangered as much by a lack of knowledge of currents as by a lack of surveys.

For important points on the Atlantic coast the Coast and Geodetic Survey has been able to publish some current predictions that are of great value to the navigator. It seems improbable that predictions of equal accuracy can ever be made for currents in Alaska, no matter how extensive our observations may be, for here it is believed that meteorological conditions affect the action of the currents to a large extent. This, however, is largely a matter of conjecture, and it may be that causes and conditions, of which we know nothing at the present time, will be discovered and their effects determined to an extent sufficient to at least enable the mariner to know the usual action of the currents and the variations that may be expected under certain meteorological conditions.

At any rate it is essential that while the surveys of the waters of Alaska are being made we provide further safeguards for navigation by acquiring as complete a knowledge as can be obtained of the actions of currents.

To accomplish this, current observations extending over a long period of time must be obtained at a vast number of points along the coast of Alaska. These observations may be obtained by parties in conjunction with other survey work or by independent parties, and may be supplemented by knowledge obtained from the experiences of merchant vessels and others along this line.

Each series of observations obtained at a station will not only be of importance in itself but will be doubly important as a means of comparison with simultaneous observations made at other points. By such comparisons it may be possible to furnish the navigator with data whereby he can estimate the current action at some critical part of his trip by noting the current at some other point where he has had an opportunity to observe its action.

MODERN VESSELS NEEDED.

In the preceding pages it has been the desire to give a clear idea of the present conditions in Alaska, as far as they relate to its coast surveys. It is the present purpose to consider the means at hand and those that are needed to bring these surveys to such completeness that the loss of vessels can not be ascribed to lack of reliable charts and sailing directions.

In the past the Bureau has been inadequately equipped for this work, but conditions are at their worst now when the commerce of Alaska exceeds anything in our history and is increasing by leaps and bounds. Since the Government is spending vast sums to provide a merchant marine, it is "good business" to take normal precautions that these vessels may safely navigate our waters.

The natural resources of Alaska have so tempted commerce that vessels have ventured into those regions far in advance of adequate surveys. The means of the Coast and Geodetic Survey for charting Alaskan waters have been and are so limited that the best that could then be done and can now be done is to shift from place to place and make examinations where industry has preceded surveys and dangers have been found by vessels striking them or where industry has established itself and demands a local survey.

The equipment for these surveys is so limited that no definite plan can be laid for their ultimate completion or for the issuing of charts that will be guides to all parts of Alaskan waters.

The making of surveys and supplying of reliable charts for the urgent needs of Alaska is a question of the number of surveying vessels and wire-drag launches available for the work. The Coast and Geodetic Survey has on its list for the survey of the coasts of Alaska the following *small* and largely *superannuated* fleet:

1. The "Surveyor" (newly built.)—This vessel is the result of the experience of the officers of the Bureau in designing a vessel for the attainment of the maximum results with the least expense. She is a steel steam vessel of 1,000 tons displacement; 186 feet in length over all; 34 feet in breadth; 12 feet draft; indicated horsepower, 1,000; speed, 11.5 knots; fuel capacity, 75,000 gallons fuel oil ; complement, 11 officers and 58 men. Built at Manitowoc, Wis., in 1917. *Now in Navy*, and not available for surveying. (See fig. 20.)

2. The "Explorer."—A wooden steam vessel of 450 tons displacement, 335 gross tons, and 228 net tons; registered length, 135 feet; breadth, 27 feet; draft, 10 feet; indicated horsepower, 400; speed, 10.3 knots; coal capacity, 85 tons; complement, 7 officers and 40 men. Built at Wilmington, Del., in 1904. In the design and construction of this vessel the utmost useful space was sought within her. To do this, some of the strengthening members usually provided in a vessel were omitted. While during her earlier work no weakness was noticed, she now shows the absence of these members. In rough seas her sides are so pliable that the bolts are subject to a shearing process. If she is continually employed in rough seas, she will soon become too weak to be of service. Not an efficient ship. It is not wise to spend much upon her. (See fig. 19.)

3. The "Yukon."—A composite steam vessel of 38 gross tons and 25 net tons; registered length, 75 feet; breadth, 15.7 feet; draft, 5 feet; indicated horsepower, 100; speed, 7.5 knots; coal capacity, 16 tons; complement, 4 officers and 13 men. Built at New York in 1898. Really a large launch. Of limited use. (See fig. 17.)

4. The "Patterson."—A wooden auxiliary steam barkentine of 719 tons displacement, 500 gross tons, and 453 net tons; registered length, 163 feet; breadth, 27.3 feet; draft, 14.2 feet; indicated horsepower, 215; speed steaming, 8 knots; coal capacity, 133 tons; complement, 12 officers and 49 men. Built at Brooklyn, N. Y., in 1882. She shows a condition normal to a ship 35 years old after unusually severe service. (See fig. 14.)

While the Bureau has these so-called steam vessels for surveying the coastal waters of Alaska, if we examine into the condition of these vessels and their suitability for the work, we shall find conditions worse than they look.

The *Surveyor* is, of course, the best-equipped vessel for the work, having been designed for the purpose. She can work in exposed waters and endure the roughest seas. The *Surveyor* is ideal in respect to her fuel capacity, using fuel oil instead of coal, and therefore able to remain at sea almost the entire season.

The *Explorer*, through the faulty construction mentioned above, is too weak to be exposed to the rough waters of outside surveys and must operate only in protected waters. It is not safe to send her to sea.

The *Yukon* is too small for any outside work, and must be employed on inside work.

The *Patterson*, a barkentine, is too weak to be used in exposed waters and too expensive in operation to be used as a house boat for inside surveys. She has lately been employed in making surveys of the inside Alaskan waters but is such an antiquated tool that the overhead cost of operation makes the results far less in quantity and more costly than they would be with a modern vessel. The *Patterson* was built 35 years ago.

Therefore the service has but one vessel (the *Surveyor*) suitable for outside work in all weathers; one small vessel for inside work (the *Yukon*) and two vessels (the *Explorer* and *Patterson*) too weak for outside work and too expensive in maintenance to use for house boats.

With such an outfit no general plan of surveying operations can be put into effect. Appropriations are dissipated here and there in detached surveys as industry and commerce develop in one section after another, or in making examinations where there are reported dangers.

The vessels, therefore, are not only too few for the work, but are not of the required character. This is at a time when the needs for hydrographic surveys were never so great.

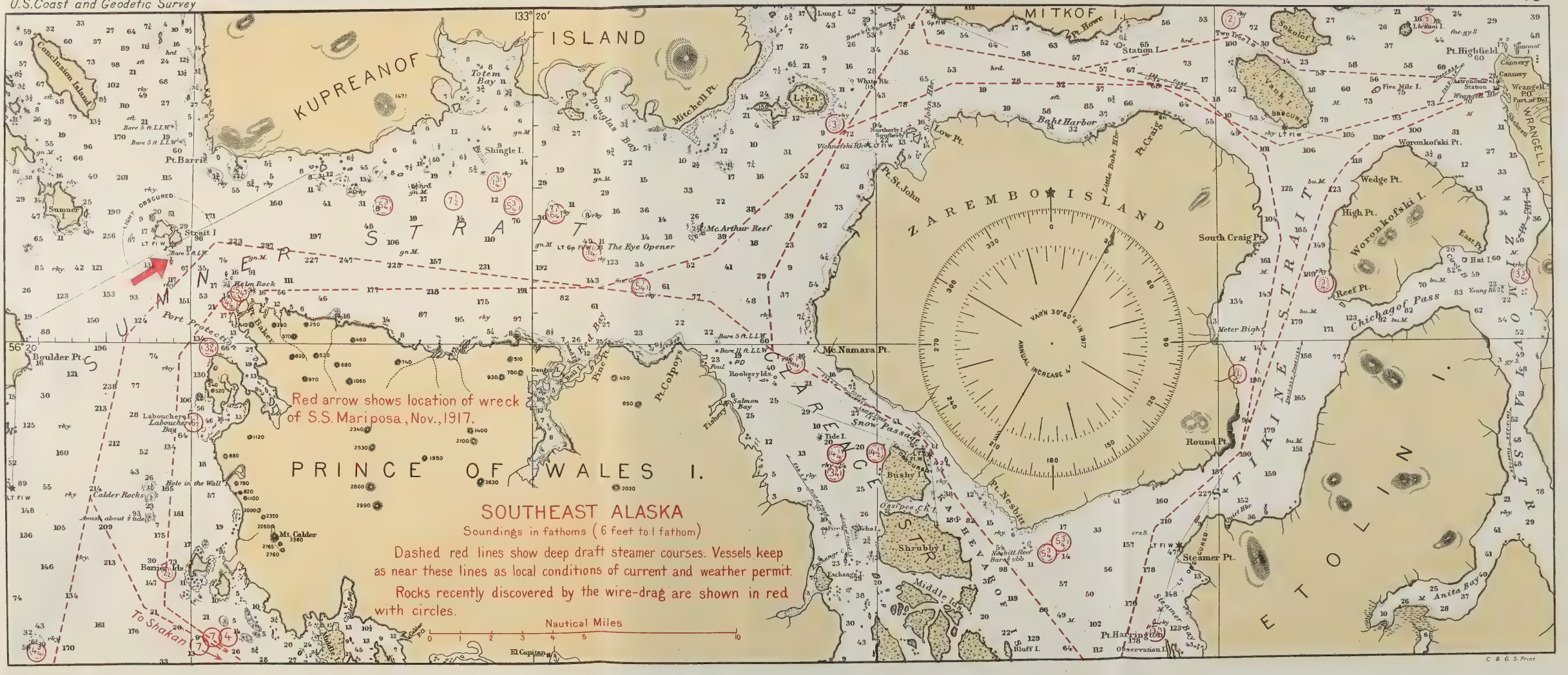
There are many square miles requiring original surveys along the coasts of Alaska, Washington, and Oregon, that should have immediate attention. During the fiscal year ended June 30, 1917, there were but three vessels available for work along this entire coast line, the *Taku* (recently condemned), the *Patterson*, and the *Explorer*. These vessels worked in the protected waters of Alaska. Nothing was done along the coasts of Washington, Oregon, and California.

Not a vessel was provided for the Coast and Geodedic Survey between 1903 and 1915. In 1916 the *Gedney*, then 41 years old, and the *McArthur*, then 40 years old, being absolutely unsafe to use, were condemned and sold. In 1917 the *Surveyor* was built to replace the *Gedney*. The Bureau now has *two less vessels* for making surveys in Alaska than it had from 1907 to 1915, and of the number available to-day one is 35 years old, very expensive to maintain, and, together with the *Explorer* is structurally so weak that she can be operated only in protected waters on work that could be done as quickly and much more cheaply were the proper facilities at hand.

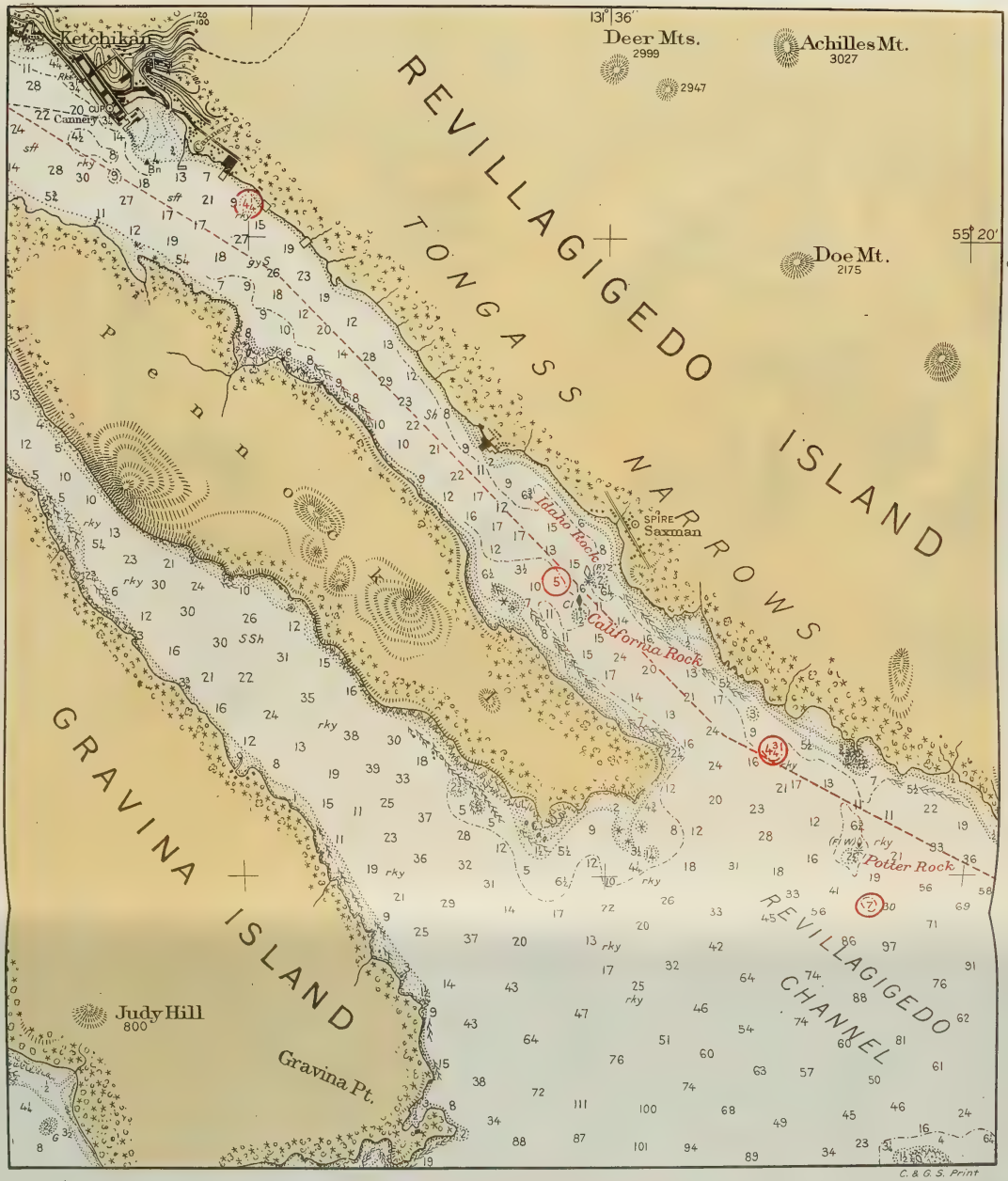
IMPORTANCE OF WIRE DRAG.

Ordinary hydrographic surveys are made with a launch or other vessel, which proceeds back and forth across the area to be surveyed until the entire area is covered by a system of sounding lines, usually parallel. The distance between the sounding lines depends on the depth and nature of the bottom and the importance of the locality. As the boat follows these lines, the depth of water is obtained by means of a lead and line, cast at regular intervals from the boat. Such surveys must be made in all regions in order that the contour of the bottom beneath the surface of the water may be known; and along the sandy portions of our coasts surveys by this method may be sufficient.

This is decidedly not the case, however, in regions where there are obstructions of small area, such as pinnacle rocks, bowlders, and sharp rocky ledges, for it is only by chance that they can be found by an ordinary hydrographic survey. It is difficult to explain just how elusive these dangers are when sought with the hand lead. Let us consider, as an analogy, a balloon drifting slowly over a town. Imagine the difficulty of throwing a weight attached to a line and hitting the tip of a church spire or the gable of a house as the balloon passes over them, and remember that the hydrographer not only can not see the obstruction beneath the surface but does not even know that it exists.


KUPREANOF ISLAND
PRINCE OF WALES I.
ZAREMBO ISLAND
MITKOF I.
WRANGELL I.
KUIU I.
ETOLIN I.
SUMNER STRAIT
CLARENCE STRAIT
STIKINE STRAIT
133° 20'
56° 20'
Red arrow shows location of wreck of S.S. Mariposa, Nov., 1917.
SOUTHEAST ALASKA
Soundings in fathoms (6 feet to 1 fathom)
Dashed red lines show deep draft steamer courses. Vessels keep as near these lines as local conditions of current and weather permit.
Rocks recently discovered by the wire-drag are shown in red with circles.
Nautical Miles
0 1 2 3 4 5 10
VARN 30° 50' E IN 1917
ANNUAL INCREASE 4'
Concrete Island
Pt. Barrie
Summer I.
Boulder Pt.
Labouchere Bay
Calder Rocks
Mt. Calder
Barnes Is.
To Shakan
Totem Bay
Shingle I.
Douglas Bay
Mitchell Pt.
Level I.
Vionnefski Rk.
Mc Arthur Reef
The Eye Opener
Port Protection
Baker
Helm Rock
Danger I.
Pt. Colpoys
Salmon Bay Fishery
Rookery Ids.
Mc Namara Pt.
Snow Passage
Tide I.
Bushy I.
Ossipee Ctr.
Shrubby I.
Middle Ids.
Exchange I.
Pt. Neshin
Neshitt Reef
Bluff I.
Pt. Harrington
Observation I.
Steamer Bay
Steamer Pt.
Round Pt.
Chichagof Pass
Meter Bight
Reef Pt.
South Craig Pt.
Pt. Craig
Baht Harbor
Low Pt.
Pt. St. John
Lung I.
Pt. Howe
Station I.
Two Tree I.
Sokolof I.
Pt. Highfield
Cannery
Vank I.
Five Mile I.
Astronomical Station
Wrangell P.O.
Part of Del.
Woronkofski Pt.
Wedge Pt.
High Pt.
Woronkofski I.
East Pt.
Hat I.
Castle R.
Young Rk.
Anita Bay
Little Baht Harbor
John Hbr.
Northerly I.
Southerly I.
Lincoln I.
Light obscured
Bare 5 ft. L.L.W.
Bare 11 ft. L.L.W.
Bare 6 ft. L.L.W.
Bare 3 ft. L.L.W.
Foul
* PD
Hole in the Wall
Awash about 9 ft.
Light obscured
LT Fl W
LT Gp Fl W (2)
Fl W
Fl R
Fl G
Gp Fl W
Obscured
Quick Fl W
Fog Det. Lt.
Ldg. Lts.
Ferry Route
Summer Resort
Cannery
Pt. Highfield
Wrangell
Pt. Stikine
Pt. Nesbitt
Steamer Bay
Pt. Harrington
Observation I.
Bluff I.
Anita Bay
Chichagof Pass
Meter Bight
Reef Pt.
Round Pt.
Steamer Pt.
Pt. Craig
Baht Harbor
Low Pt.
Pt. St. John
Zaremba Island
Kuiu I.
Etolin I.
Wrangell I.
Mitkof I.
Kupreanof Island
Concrete Island
Summer I.
Boulder Pt.
Labouchere Bay
Calder Rocks
Mt. Calder
Barnes Is.
To Shakan
Totem Bay
Shingle I.
Douglas Bay
Mitchell Pt.
Level I.
Vionnefski Rk.
Mc Arthur Reef
The Eye Opener
Port Protection
Baker
Helm Rock
Danger I.
Pt. Colpoys
Salmon Bay Fishery
Rookery Ids.
Mc Namara Pt.
Snow Passage
Tide I.
Bushy I.
Ossipee Ctr.
Shrubby I.
Middle Ids.
Exchange I.
Pt. Neshin
Neshitt Reef
Bluff I.
Pt. Harrington
Observation I.
Steamer Bay
Steamer Pt.
Round Pt.
Chichagof Pass
Meter Bight
Reef Pt.
South Craig Pt.
Pt. Craig
Baht Harbor
Low Pt.
Pt. St. John
Lung I.
Pt. Howe
Station I.
Two Tree I.
Sokolof I.
Pt. Highfield
Cannery
Vank I.
Five Mile I.
Astronomical Station
Wrangell P.O.
Part of Del.
Woronkofski Pt.
Wedge Pt.
High Pt.
Woronkofski I.
East Pt.
Hat I.
Castle R.
Young Rk.
Anita Bay
Little Baht Harbor
John Hbr.
Northerly I.
Southerly I.
Lincoln I.
Light obscured
Bare 5 ft. L.L.W.
Bare 11 ft. L.L.W.
Bare 6 ft. L.L.W.
Bare 3 ft. L.L.W.
Foul
* PD
Hole in the Wall
Awash about 9 ft.
Light obscured
LT Fl W
LT Gp Fl W (2)
Fl W
Fl R
Fl G
Gp Fl W
Obscured
Quick Fl W
Fog Det. Lt.
Ldg. Lts.
Ferry Route
Summer Resort
Cannery
Pt. Highfield
Wrangell
Pt. Stikine
Pt. Nesbitt
Steamer Bay
Pt. Harrington
Observation I.
Bluff I.
Anita Bay
Chichagof Pass
Meter Bight
Reef Pt.
Round Pt.
Steamer Pt.
Pt. Craig
Baht Harbor
Low Pt.
Pt. St. John
Zaremba Island
Kuiu I.
Etolin I.
Wrangell I.
Mitkof I.
Kupreanof Island

C & G. S. Print



SOUTH EAST ALASKA

Soundings in fathoms (6 feet to 1 fathom)

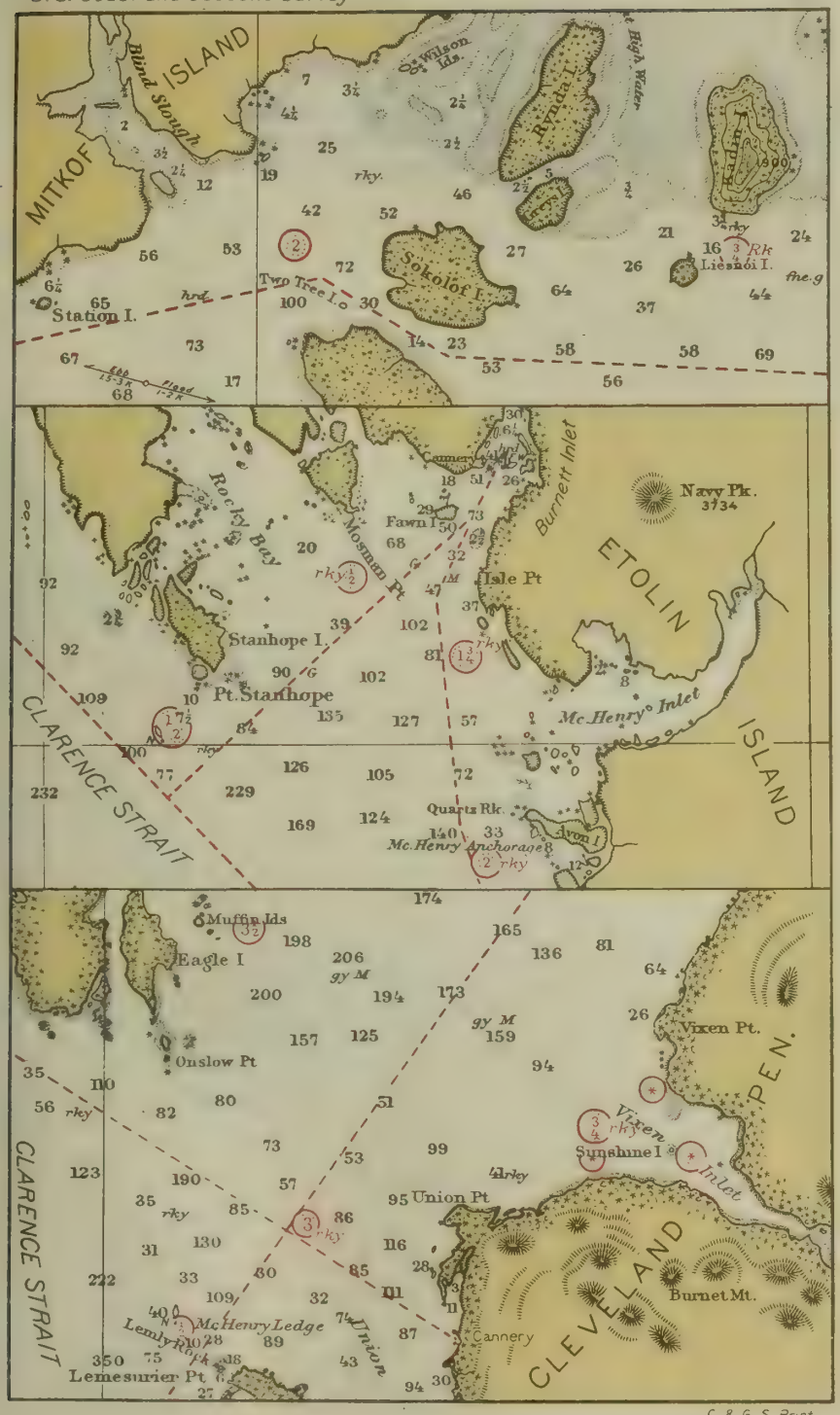
Rocks recently located with wire-drag are shown in red with circles

Regular steamer route is shown by a dashed line in red. Nearly all vessels in Alaska trade touch at Ketchikan.

Note the California Rock, the Idaho Rock, and the Potter Rock, each rock named from the vessel striking it.

Nautical Mile

0 1/4 1/2 3/4 1



SOUTHEAST ALASKA

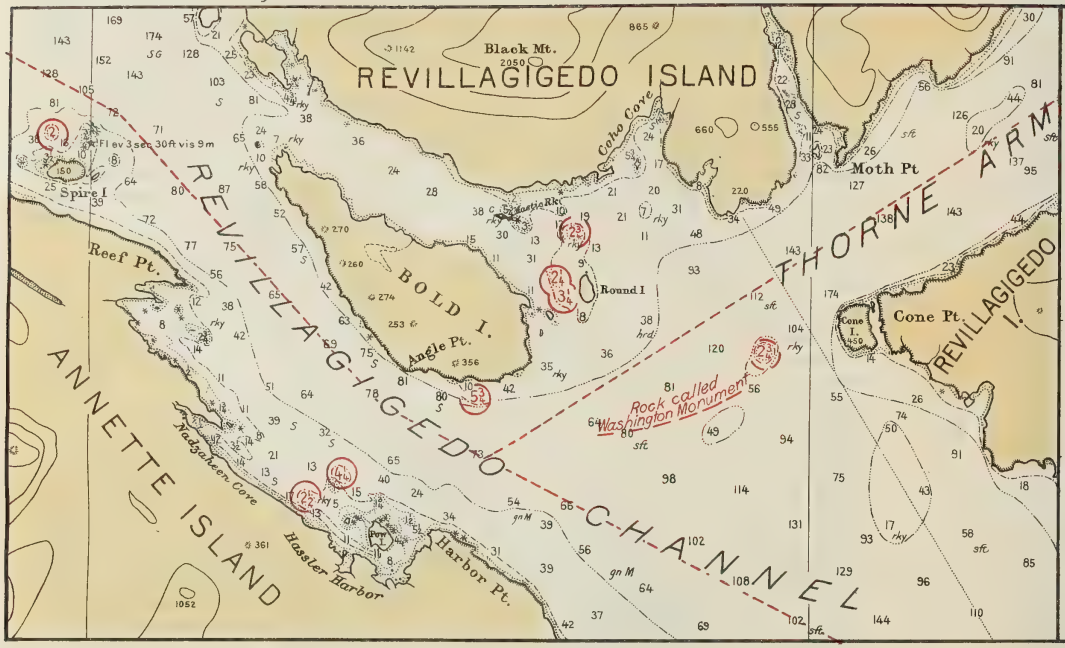
Soundings in fathoms (6 feet to fathom)

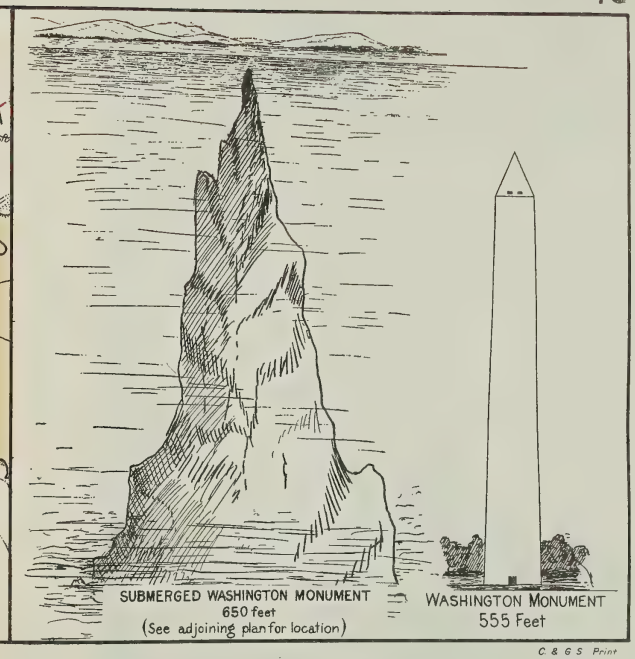
Dashed red line shows the regular sailing line for large steamers.

Recent finds of pinnacle rocks by the wire-drag are shown in red with circles. The previously charted depths in black indicate from 30 to 100 fathoms, and demonstrate the imperative need of resurveys of all these waters.

Nautical Miles

0 1 2 3 4 5





C & G S Print

SOUTHEAST ALASKA

Soundings in fathoms (6 feet to fathom)

Dashed red lines show main steamer routes.

Recent finds of pinnacle rocks are shown in red with circles.
The previously charted depths shown in black demonstrate the need of resurveys in this important thorofare by wire-drag.

Nautical Miles

1 2 0 1 2 3 4

The submerged "WASHINGTON MONUMENT" (pinnacle rock), height 650 feet, found near main steamer route in Alaskan waters in 1915 by the wire drag; only 17 feet of water covers this pinnacle.
The Washington Monument we know so well is 555 feet in heighth.

It has therefore been necessary to supplement ordinary hydrographic surveys by some means of finding all of these dangers in regions where they exist, and for this purpose the Coast and Geodetic Survey uses an apparatus known as the wire drag. Starting on the Atlantic coast in 1904 with an apparatus patterned after the wire sweep used at that time by the United States Army Engineers on the Great Lakes, the Survey has gradually developed and perfected equipment and methods of operation until at the present time the modern wire drag is a wonderfully efficient mechanism capable of covering large areas rapidly and finding therein every danger to navigation that exists.

Stated briefly, the wire drag consists of a horizontal wire maintained at any desired distance below the surface of the water by an arrangement of weights and adjustable upright cables extending up to surface buoys. This apparatus is towed by two launches, one at each end. As the drag passes through the water it will catch and show the location of any obstruction extending above the plane of the horizontal wire. Knowing the location of the obstruction, the least depth on it can be easily found by sounding with lead and line from a small boat.

That pinnacle rocks, the most dangerous of all obstructions to navigation, are present in Alaska waters can be easily predicted from a study of the adjoining land areas; and in a few cases such rocks, their existence indicated by kelp extending up to the surface of the water, were discovered by hydrographic parties. With the increase in the commercial importance of Alaska and the number of ships plying its waters came an increase in the number of accidents to vessels, with loss of life and property; and the fact that many of these accidents were due to striking uncharted rocks caused a realization of the fact that not only do pinnacle rocks exist in large numbers but that they occur in the most unexpected localities. It was, of course, evident that all these dangers must be found in order to safeguard vessels navigating the waters of Alaska, and wire-drag work was accordingly started in 1914. Since that time it has been prosecuted as rapidly as funds would permit. (See figs. 43, 44, and 45.)

The startling number of dangers to navigation discovered with the wire drag during the short time that it has been used in Alaska waters strongly emphasizes the fact that in regions where the shores are rocky practically all the navigable waters, out to the 50-fathom curve, must be dragged in order to provide the assurance of safe navigation to which navigators, shipowners, and the general public are so plainly entitled. This is a huge task, but it is imperative that it be prosecuted with vigor and carried to the earliest possible conclusion.

One of the most striking illustrations of a discovery of a submerged pinnacle rock was in 1914, located near the *main* steamer route. The rock with only 17 feet of water covering its peak, is now called the "Washington Monument." (See fig. 46.)

WIRE-DRAG LAUNCHES SHOULD BE BUILT AND NOT HIRED.

It has been stated that the wire drag is towed by two launches, one at each end. When wire-drag work was first begun on the Atlantic coast a short drag, constructed of light materials, was used, and almost any type of small launch could be used to carry the crude operating machinery and for towing purposes. When this work was started in Alaska in 1914, however, the equipment and methods of operation had been developed to such an extent as to require larger and more powerful launches—launches of special design and construction.

For work in Alaska the two towing launches should each have a length of from 50 to 60 feet and a minimum speed of 10 miles per hour. They should be of sturdy construction and should have plenty of clear deck space to permit the installation of the machinery used for setting out and taking in the drag. These boats are supplemented by one or more smaller

launches that are used for patrolling the drag, sounding on shoals, clearing the drag from shoals, etc.

There are comparatively few towns in Alaska available for use as headquarters for a wire-drag party, and it is therefore necessary to use, in addition to the boats menticned above, a larger vessel of sufficient size to carry a considerable amount of supplies and to provide living accommodations for the party on the working grounds. This vessel is frequently used for towing one end of the drag and also acts as a tender for the subparties, as a wire-drag party in Alaska must carry on triangulation and topography in addition to the drag work.

Owning no wire-drag vessels, the Coast and Geodetic Survey has been forced to charter boats for this work in Alaska, with the result that the progress of the work has been retarded and the unit cost kept at an unnecessarily high figure. This condition is due to two causes—first, vessels suitable for wire-drag work are practically nonexistent; and, second, extremely high rental prices must be paid for such boats as can be obtained.

Suitable boats are difficult to obtain for the following reasons:

1. Pleasure launches usually have enough power for the work but their hulls are too weak.
2. Fishing and working launches are generally of sturdy construction but are usually low powered.
3. Small tugs have too low freeboard and so much power that they can not be regulated for towing the drag.

Rentals for vessels that can be used for wire-drag work are high for the following reasons:

1. Owners of launches that have never been used for wire-drag work are unfamiliar with conditions, and have no means of estimating the probable cost of repairs or deterioration.
2. The risk of damage or loss must be assumed by the owner, though he has no voice in the matter of how or when the launches will be used, and insurance rates in Alaska, due in a large measure to lack of wire-drag surveys, are very high.
3. Staunch fishing boats with good engines are the best suited for wire-drag work of any that can be chartered, but here the Government must compete with the amount that the owner can make in the fishing industry, where generous earnings may generally be relied on.

And to the excessive cost of wire-drag work due to high rentals there must be added the overhead expense incurred by the Government in obtaining bids, inspecting and selecting boats, and the cost of labor and time required to install the equipment on the vessels at the beginning and to remove it at the end of the season. This expense averages $850 per party per season.

As an illustration of the conditions outlined above, the case of a launch that has been used for several seasons for wire-drag work in Alaska may be cited. This illustration is selected from others of a similar nature for the reason that the launch in question is regarded as the most suitable of any boat it has been possible to charter. This launch was designed and built for a seine boat, and her speed is not over 7 miles per hour.

In Alaska it has been found that the actual working time of a wire-drag party costs about $1 per minute, that the average time required to run to and from the working grounds with. 7-knot boats is two hours per day, and that the number of working days averages 100 per season Considering the question of speed, therefore, it is evident that, with 10-knot boats, the average working time would be increased by about 40 minutes per day, and that the value of the time thus saved would amount to about $4,000 for one season. The time saved would, of course, be used to increase the output of work.

As regards rental price, it is estimated that, considering the original cost of this launch and the cost of repairs and operation, the owner has realized a return of about 50 per cent per year on his investment.

We see, therefore, that the practice of chartering vessels for wire-drag work in Alaska has resulted in delay and expense for installing and removing equipment, in loss of time and decrease in output due to inadequate boats, and in the payment of rentals sufficient, in from two to three seasons, to build these boats.

There is only one remedy for present conditions, and that is for the Government to build and own its wire-drag vessels. A special type of boat must be built for wire-drag work, just as a boat of special design must be built for placing and tending aids to navigation or for hunting submarines.

When such vessels are available, and not until then, can the wire-drag work, so essential to the safety of vessels navigating the waters of Alaska, be prosecuted economically, systematically, and in a businesslike manner.

In concluding this matter no one can better express conditions than to quote from a letter recently received from one of our engineers in charge of a wire-drag party:

> According to all reports we have been fortunate in having an unusually favorable season for work, but I am afraid that it is about over, for heavy squalls and rain are beginning to make things interesting and the weather seems to be getting generally unfavorable.
>
> It would not be so bad if our end launch could only take care of herself, but it is asking almost too much of a 25-horsepower guiding launch to take up the drag in a heavy squall that may last five minutes or five hours, and then get a line to the end launch and furnish enough power to give her steerageway.
>
> I wish that the opponents of Government-owned wire-drag boats could have spent the season with us and personally experienced the constant annoyance and obtained an idea of the inefficiency of the present system of chartering boats, especially in regions where suitable launches are few and far between. I believe that this is the first wire-drag work that has been done almost entirely out of sight of land, and in what, because of strong currents, is even worse than the average open sea; and it has been necessary to do it with launches that we would hardly consider adequate for work in [protected] Cape Cod Bay.

TIME REQUIRED TO MAKE A FIRST SURVEY.

The task of surveying the coastal waters of Alaska is a large one. It is estimated, however, that three able seagoing surveying vessels can complete a first survey of the exposed coast, except the Arctic Ocean, in 40 years, including soundings along the entire coast out to the 1,000-fathom curve.

But the public would by no means have to wait 40 years to derive some benefit from these surveys. The work would be followed immediately in opening localities to commerce which are now unsurveyed. The most important work would be undertaken first, and within a year after the vessels were made available the public would begin to reap the benefit in the form of greater security to lives and property.

The survey of the exposed waters is the more costly one by reason of the fact that the more expensive units must be used for its prosecution. The survey of the less exposed waters can be done by smaller vessels or shore parties, the only requirement for this purpose being that the necessary trained officers and men shall be furnished for the work.

PROBABLE COST.

In Chapter I a statement is furnished giving the total cost to date of the coast surveys already made in Alaska, showing the average annual cost by five-year periods. The average cost on the basis of the past five years is about $231,000, and the greatest amount ever expended

was $262,000 in the fiscal year 1915. With the present vessel equipment it has been shown that no comprehensive plan for surveying the coast of Alaska is possible.

It has been stated that the coast of Alaska, not including the Arctic Ocean, can be surveyed in 40 years, and the following estimate is based on that program.

The steamer *Surveyor* cost approximately $235,000, and it is estimated that it would cost $400,000 to duplicate her at this time.

It is estimated that the boat equipment of each wire-drag party will cost approximately $75,000. A small vessel for use in the protected inside waters can probably be furnished for $50,000. The following is an estimate of the cost of the *first* boat equipment needed for a comprehensive survey of Alaska in 40 years:

3 large vessels	$1,200,000
8 launches for two wire-drag parties	150,000
4 small vessels for inside waters	200,000
Total	1,550,000

Given the necessary vessel equipment, the average annual cost for prosecuting the work, including the pay of officers and crew, repairs of vessels, equipment, outfit, and stores, is estimated as follows:

3 vessels	$300,000
2 wire-drag parties	60,000
4 small-vessel parties	80,000
Total	440,000

MORE TRAINED OFFICERS ESSENTIAL.

In addition to the vessel equipment, more trained officers are needed to enable the Bureau to carry out this program. The total number of hydrographic and geodetic engineers, junior hydrographic and geodetic engineers, and aids, who form the technical surveying officers of the Bureau, is now fixed by law at 124. These officers perform the administrative work of the Bureau in Washington and carry on the surveys on the Atlantic, Gulf, and Pacific coasts of the United States, Alaska, Hawaiian Islands, Philippine Islands, Panama, Porto Rico, and Virgin Islands of the United States.

The work of the Bureau has been so handicapped by the shortage of officers that it has been necessary to use some untrained men in all of its parties.

In 1915, there were employed in the survey of the coast of Alaska 36 engineers and 11 other officers, a total of 47; in 1916, 24 engineers and 11 other officers, total 35; and in 1917, 24 engineers and 14 other officers, a total of 38. The greatest number of officers ever employed by the Coast Survey in the survey of the coast of Alaska was in 1915, when 47 engineers and other officers were employed there.

To properly man the vessels and other parties enumerated above for a comprehensive program for surveying the coast of Alaska there will be required 67 officers and, in addition, 10 officers will be required for carrying on surveys in the interior of Alaska, as mentioned in Chapter IV. There are also required 19 officers for one large vessel and other parties for carrying on urgently needed surveys on the Pacific coast of the United States. It will thus be seen that a total of 96 officers is required for surveying the Pacific coast of the United States and Alaska. In view of the fact that the entire number of officers authorized by law for the Coast and Geodetic Survey is 124, it is needless to say that the present force of officers is entirely inadequate for the work.

Having in mind the work needed in other parts of the United States and insular territories, it can be stated that not to exceed 45 engineers will be available at the close of the war for the work on the west coast of the United States and Alaska.

The coast survey of Alaska can not be carried on economically without an adequate supply of trained officers. Our larger surveying units, such as the *Surveyor*, carry 11 officers, and that vessel will operate five parties during the surveying season. In other words, the loss of two officers from a vessel will lower the output of work approximately 20 per cent, notwithstanding the fact that the cost of the vessel, crew, outfit, and all field expenses will remain practically the same. These officers must be trained in the very special work which they are required to do. Their principal duty, of course, is the engineering one of executing surveys of the highest precision. In addition, these officers are called upon to handle the vessel and boat equipment across broad expanses of the open sea and to operate them in unsurveyed waters. *Not less than three years' training is necessary to fit these officers to be safely intrusted with important detached duties and it can not be too strongly urged that the officers are needed now in order that they shall receive the necessary training to take up the work when the vessels are available.*

CREWS FOR VESSELS A VITAL NEED.

Another vital need in connection with the hydrographic work in Alaska is to remedy the situation with regard to crews on the vessels of the Coast and Geodetic Survey, which has long been a serious one, and in 1917 became so accute that a number of the vessels had to be laid up as a result of the impossibility of getting and keeping sufficient men to enable them to operate efficiently.

The conditions of labor in the United States have undergone an enormous change in the past few years. Labor has demanded and received higher wages and better working conditions. The Coast and Geodetic Survey, however, among other Government institutions, has been unable to keep pace with that change, and the result has been that just in the proportion as it failed to do so the efficiency has been reduced.

There are a number of factors which make service in the Coast and Geodetic Survey undesirable from the point of view of the enlisted man. The pay is less than he can earn elsewhere, either in the merchant marine or in various industries ashore; the work is of more than average difficulty and must sometimes be continued through much longer hours than the eight hours to which he is accustomed elsewhere; the living conditions in the crowded forecastles of small and antiquated wooden vessels are anything but attractive; and, finally, his employment is only temporary and may be terminated at any time, so that he has not even the incentive of a permanent position to compensate him for the other undesirable features enumerated.

The constant change and upheaval in the crews which result from these conditions are strikingly portrayed in the following table, which shows for each Coast Survey vessel for use in Alaskan waters the complement allowed and the number of persons in the complement during the fiscal year 1917:

Vessels.	Stations.	Complement.	Persons in complement.
Surveyor	Atlantic coast (en route to Alaska)	58	[a] 85
Patterson	Pacific coast	49	[b] 132
Explorer	do	39	[b] 124

[a] In commission only since June 11, 1917.

[b] In commission only about 7 to 8 months of the year.

Even this table does not tell the whole story, as there is not one of these vessels which has not been continuously shorthanded through inability to obtain recruits.

These factors, the undesirable type of men which alone can be obtained under existing conditions, and the inability to keep men even of this type, result in a great loss in efficiency.

The Coast Survey ships, as surveying units, are carefully planned, and their equipment and personnel are arranged so as to provide for the most efficient and economical operation of three to five surveying parties. In these parties the enlisted men form an integral part. They are not there merely to man the ship; they take an active part in the surveying work. They are the recorders, rodmen, leadsmen, tide observers, coxwains or engineers of the surveying launches, operators of the sounding machines, etc. There are no idlers or supernumeraries; each man (with the possible exception of the mess force) has his definite place in the organization, and so the shortage of a single man means a loss in efficiency, while a shortage of three to five men means that one less party can be worked. This means that in return for the saving in the wages of these men (a negligible quantity) the efficiency of the vessel, which must be measured by the amount of work accomplished, is reduced from one-third to one-fifth.

It costs from $30,000 to $60,000 a year to operate one of these ships, depending on size and location, and it follows that a shortage of a few men in the complement will, for a ship engaged in combined operations, result in a loss of $6,000 to $20,000 a year.

Losses occur as a result of the lack of training of the men in the specialized work which they are required to perform. The enlisted men in the Coast Survey require such training quite as much as do the men in the Army or Navy. As already indicated, in the former service these men do not merly shovel coal, scrub decks, or clean brass; they take an active part in the surveying operations, only a little less important than that of the officers, and no amount of efficiency on the part of the officers can compensate for their failure to perform their work properly. In these days of increased draft, ships must pass close to the bottom, particularly along the Atlantic coast. The officers may properly find and locate the channels or shoals, but if the leadsman does not read the depths correctly, if the recorder does not record them properly, or if the tide observer goes to sleep or goes off somewhere for the day and then "fakes," the records of his staff readings, the result may be the loss of a vessel through an error in the chart.

At least a season's work is necessary to properly train these men in such duties. Yet, the record of changes in complement above quoted shows that the complements change on an average of two to three times a year. Furthermore, the men that present conditions enable the Survey to obtain are, as a rule, of a type that have no desire to become proficient in the work.

It must be clearly understood that these conditions are not merely the result of the present world conflict. They existed in a serious degree before that conflict began, and the war has merely exaggerated them to such an extent that, as already stated, it has become necessary to lay up certain ships which could no longer be operated efficiently.

An effort has been made to compute the cost of these losses in efficiency, and from the best data available it appears that the loss by the seven vessels operating in the United States during the past year is about $82,000. One case, that of the *Patterson*, may be cited as typical.

The *Patterson* works in Alaska in the summer and winters in Seattle. Last spring she was detained 20 days in Seattle through inability to obtain men. She finally sailed with a shortage of five men. After working for about six weeks with this reduced complement, and its resultant loss of efficiency, the ship was compelled to go to port. Here five days were lost through drunkenness among the crew and their refusal of duty. She finally got away with a shortage of seven men. Efforts to recruit men in Seattle to fill these vacancies were unavailing; men would not consider the $60 a month offered when they could readily earn $100 or over elsewhere.

Work was continued with this reduced complement, therefore, until early in August when the situation was relieved by discontinuing the work of another vessel, the *Explorer*, which had been operating under conditions equally unsatisfactory. Enough men were kept aboard the *Explorer* to bring her to Seattle, where she was laid up; the remainder of her crew was transferred to the *Patterson*.

The estimated cost of this decreased efficiency on the *Patterson* alone is $24,500.

All possible means have been used by the Survey to improve these conditions. The pay of the crews has been increased to an amount considerably beyond that available under the existing appropriation. If the ships were operated during the 1918 fiscal year on the same basis as they have been for some years past, there would be a deficiency of $30,000 in the appropriation for pay of crews. The fact that officers and vessels of the Survey have been taken over by the Navy relieves the situation; otherwise, it would have been necessary either to obtain a deficiency appropriation from Congress or to lay up at least part of the ships in the spring of 1918.

For this situation partial but insufficient remedy would be to pay the crews a wage as high or slightly higher than they would obtain elsewhere.

This plan, in a modified form, has already been adopted by the Bureau, and in the 1919 estimates the fund for pay of crews is based on the wage scale recently adopted for the governmental and private merchant fleets by representatives of the Department of Commerce, the Department of Labor, the Shipping Board, employers, and employees.

There are, however, a number of reasons why this increase in wages will not completely solve the problem under consideration.

1. The equality in wages is only apparent, for the earnings of merchant seamen are materially increased by overtime pay, which it is impracticable to grant employees in the Coast and Geodetic Survey.

2. The Survey vessels, working near ports, must compete not only with the merchant marine but also with the labor markets ashore. These latter are glad to pay $75 to $100 per month for the men to whom the Survey can offer only $60.

3. Employing men for the season only, even if they could be induced to remain for that period, will not afford a complete solution. As has already been shown, the maximum effectiveness in the work of the Survey can be obtained only with trained crews. It requires a season to train these men, and under the above plan they would be discharged just when they were beginning to be effective, and the following season the same training process would be begun anew.

The truth is that increased pay is only one element entering into the final solution of the problem. The final solution rests on a complete readjustment of present conditions.

The men must eventually be given permanent employment at a fair wage and under comfortable living conditions. They must have before them some prospect of advancement for faithful service, and their rights must be fully safeguarded. In return, they must be required to live up to the terms of an equitable contract, and there must be authority for dealing effectively with the occasional undesirable who refuses to do so. To bring this about, the authority of Congress is needed for the enlistment of crews similar to that now existing for the Coast Guard.

Such a readjustment will make it possible to build up a permanent organization of sober, industrious men, devoted to the Survey and its interests through long association, and will result in an increase of 20 to 25 per cent in the efficiency of every vessel.

CHAPTER IV.—FIRST SURVEYS OF INTERIOR ALASKA NEEDED.

CHARACTER OF THE WORK NEEDED.

It would be a mistake to leave the subject of water surveys in Alaska without calling attention to the great need for establishing monuments (survey control points) throughout the Territory and determining their latitude, longitude, and elevation.

There are no such points established in the interior of Alaska to-day except along the international boundary. There should be triangulation stations (survey control points) established along each of the rivers on which there are routes of travel, and precise leveling bench marks should also be established along these rivers, in order to furnish the starting points for the control of various Government and private surveys and maps which will be made from time to time to facilitate the development of the industries and commerce of Alaska.

In advocating a movement in the United States to expedite the mapping of the country, Prof. W. M. Davis, of Harvard University, wrote an article which appeared in the October 13, 1916, number of Science. He said in part:

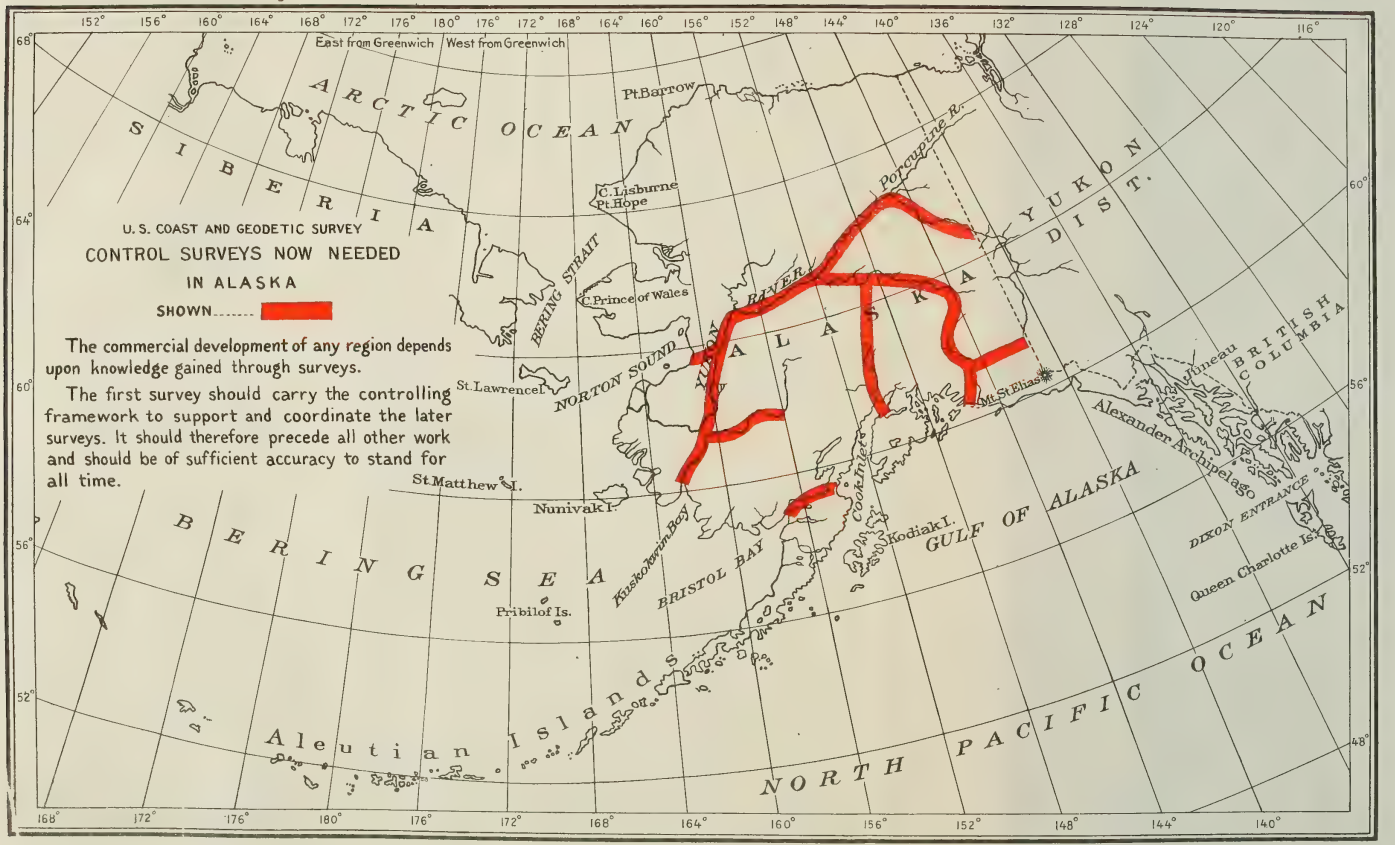
> Every industry, art and science which demands a knowledge of the lay of the land is benefited by good maps of the area in which it is carried on. The general location of railways and highways, the planning of water supply, irrigation and drainage projects, the prosecution of the geological, soil and forest surveys, the development of the water powers and the installation of electric transmission lines, the promotion of large scale realty transactions, such as are common in the less settled parts of the country, are all aided immensely if good topographical maps of their areas are available, and are correspondingly embarrassed if such maps are wanting. Practical men, who have had experience in mapped and unmapped areas can testify to the ease and the difficulty of work in the two cases.

There is no place in the territory of the United States where maps are of more value in industries of various kinds than in the interior of Alaska. These maps, of course, should be good ones, and the only possible way to have a good map is to have a properly coordinated and consistent system of control.

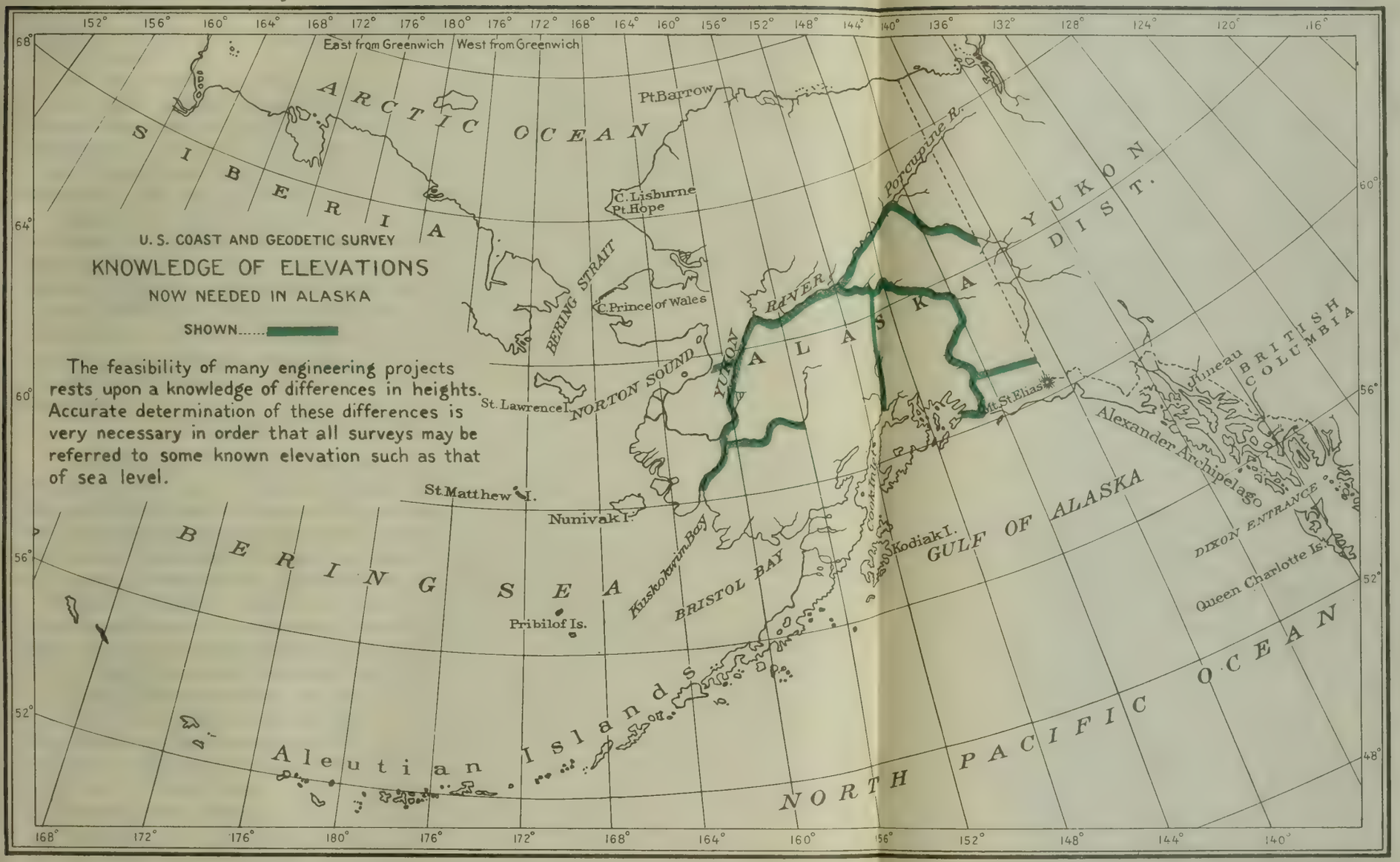
The method of determining the geographic positions of monuments which are used for the control points of the topographic maps and surveys of various kinds is triangulation. In this method a base line or distance between two established points is measured and other distances between contiguous points are determined by computations from this known length and the measured angles of the triangles in the scheme of triangulation. The latitudes of these stations are the distances from the equator and the longitudes are the distances from the meridian passing through the observatory at Greenwich.

Accurate elevations are determined in the interior of a country by lines of precise leveling which are extended inland from tidal stations. At these tidal stations the relation between mean sea level and some object on shore is determined by long series of observations. The mean sea level is considered to be zero in the leveling net and all other elevations are referred to it.

With the longitude and latitude known, for each of a number of triangulation stations, and the elevations available for bench marks, we have what may be considered a framework upon which detailed surveys can be made. If the area is local and can never be connected by


U. S. COAST AND GEODETIC SURVEY
CONTROL SURVEYS NOW NEEDED
IN ALASKA
SHOWN.....
The commercial development of any region depends upon knowledge gained through surveys.
The first survey should carry the controlling framework to support and coordinate the later surveys. It should therefore precede all other work and should be of sufficient accuracy to stand for all time.
East from Greenwich
West from Greenwich
ARCTIC OCEAN
SIBERIA
Pt. Barrow
C. Lisburne
Pt. Hope
BERING STRAIT
C. Prince of Wales
YUKON RIVER
Porcupine R.
YUKON DIST.
ALASKA
NORTON SOUND
St. Lawrence I.
St. Matthew I.
Nunivak I.
Mt. St. Elias
Juneau
BRITISH COLUMBIA
Alexander Archipelago
DIXON ENTRANCE
Queen Charlotte Is.
Cook Inlet
Kodiak I.
GULF OF ALASKA
BERING SEA
Kuskokwim Bay
BRISTOL BAY
Pribilof Is.
Aleutian Islands
NORTH PACIFIC OCEAN

C & G. S. Print


U. S. COAST AND GEODETIC SURVEY
KNOWLEDGE OF ELEVATIONS
NOW NEEDED IN ALASKA
SHOWN.....
The feasibility of many engineering projects rests upon a knowledge of differences in heights. Accurate determination of these differences is very necessary in order that all surveys may be referred to some known elevation such as that of sea level.
East from Greenwich
West from Greenwich
ARCTIC OCEAN
SIBERIA
Pt.Barrow
C.Lisburne
Pt.Hope
C.Prince of Wales
BERING STRAIT
Porcupine R.
YUKON DIST.
YUKON RIVER
ALASKA
BRITISH COLUMBIA
Juneau
Mt.St.Elias
Alexander Archipelago
St.Lawrence I.
NORTON SOUND
St.Matthew I.
Nunivak I.
Kuskokwim Bay
BERING SEA
BRISTOL BAY
Pribilof Is.
Kodiak I.
GULF OF ALASKA
DIXON ENTRANCE
Queen Charlotte Is.
Aleutian Islands
NORTH PACIFIC OCEAN

C & G S. Print

surveys and maps with any other (such for instance as an island), then extensive primary triangulation and precise leveling are not necessary, but in an area the size of Alaska each locality that is the scene of present industry and commerce will undoubtedly be connected by surveys and maps with other localities. If we do not have such a framework, as mentioned above, there will be serious discrepancies when two local surveys or maps are joined. There will be offsets, gaps or overlaps, which will be sources of trouble until the whole work has been properly adjusted to the strong control work that must be done to make the local surveys fit into each other.

It is the experience of all civilized nations that for the economical surveying and mapping of their areas, primary triangulation and precise leveling have been required. Many of the countries have followed the surveys and maps by primary triangulation and precise leveling while others have had the control work precede the operations upon which the maps are based. In the United States much of the surveying of the public lands preceded any triangulation whatsoever, with the result that many of the maps have not the proper control.

Surveying is now being done in the interior of Alaska by several organizations of the Government, especially the United States Geological Survey, the General Land Office, and the Forest Service. There are, of course, mineral surveys made also. These organizations are now operating without primary control points and there is no way of telling just where those local maps and surveys are located, except those that are made near the coast. An approximate position of a survey may be obtained by astronomic observations but the latitude and longitude of such a survey may be in error by as much as one-fourth or one-half mile, due to the local attractions of the mountain masses on the plumb line to which all astronomical observations are referred.

WHERE CONTROL SURVEYS SHOULD BE MADE.

It would seem to be most economical method of mapping Alaska to have long arcs of primary triangulation and lines of precise leveling extended throughout the area where maps are being made and where they will be made in the near future. There are some areas which can await the development of the country before the primary triangulation and precise leveling are done. This control work should be done very soon after opening of a transportation route but should not in general precede it, as otherwise the work will be excessively expensive.

There is immediate need for a system of primary triangulation down the Yukon River, from its crossing at the one hundred forty-first meridian to the mouth, or at least to St. Michael. A line of precise levels should follow along this same route. Another line of precise levels and an arc of triangulation should be carried up the Copper River from its mouth, and on to Fairbanks. A spur should be carried from this system to the one hundred forty-first meridian, at a point about 70 miles north of Mount St. Elias. Another route which should be followed by primary triangulation and precise leveling is along the Alaska Railway, from the head of Cook Inlet northward. The other important work should be done along the Kuskokwim River, from its mouth to the Yukon, with a spur line running eastward along the Odgovigamut River. A small piece of work should be done between Cook Inlet and Bristol Bay. Here only triangulation is needed. All of this needed work is shown. (See figs. 47 and 48.)

The work mentioned above would, it seems, meet all the immediate needs for primary geodetic work in Alaska. It is needed for the interior as well as to strengthen the coast triangulation which is used to control the sailing charts. The work outlined is, of course, not all that is needed, but additional work can be done and planned as occasion demands.

TOPOGRAPHIC ENGINEERS AND MINERAL SURVEYORS NEED ELEVATIONS, LATITUDES, AND LONGITUDES.

A letter was received from the Director of the United States Geological Survey sometime ago which, it is believed, gives a clear statement of the need for triangulation in Alaska. What is said in regard to the triangulation might have been said also in regard to precise leveling. This letter follows:

I am pleased to see that the approved estimates for the fiscal year 1913 include an increase for the work of your Bureau in determining the geographic positions and more especially because they provide for the extension of a triangulation in Alaska from the international boundary to Bering Sea. I need hardly tell you how valuable the results obtained by the Coast and Geodetic Survey in the United States are to this service. * * *

The special purpose of this letter is to direct your attention to the urgent need of a general system of triangulation in Alaska and especially in the Yukon Valley. The accurate location of areas under survey in this northern region will only be possible on the basis of a triangulation. If this is understood now, it will settle the problem of location for all time to come. If the triangulation is not made, endless work and much expense will be involved in the adjustment of future surveys and maps.

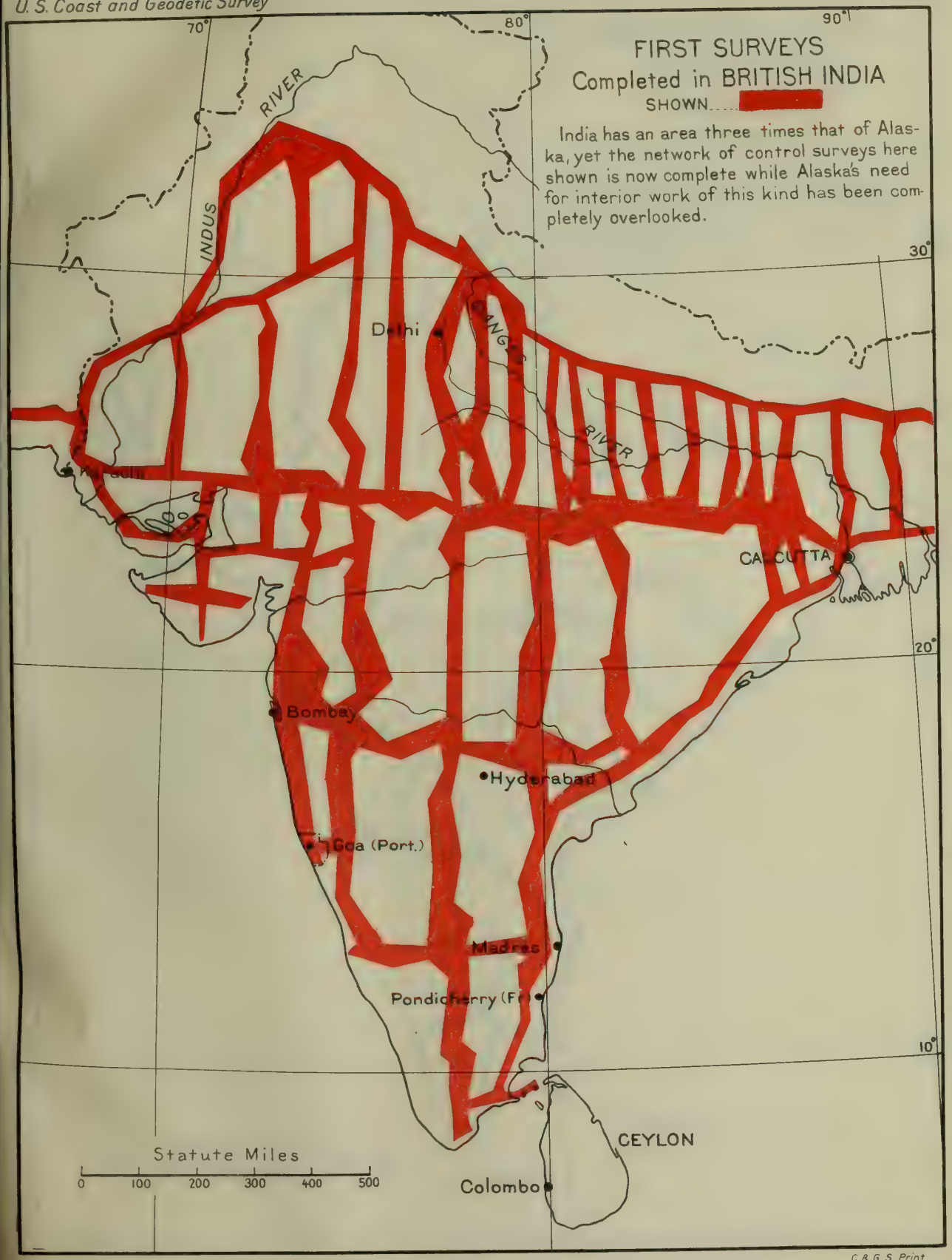
As the Geological Survey is engaged in the preparation of base maps necessary to the study of the mineral resources of Alaska, it is vitally interested in having the triangulation extended over the more important parts of the Territory as soon as possible. Such a triangulation would also be the first step toward the setting in each mining district of one or more monuments whose positions have been exactly determined. This would give an accurately located tie point for every mineral survey, and by absolutely fixing the position of each survey, would avoid endless disputes in the future. In my opinion great economies will be made in the future by starting this work at once. I therefore urge you to undertake it as soon as means permit.

A short time ago a letter was received from one of the members of the Alaskan Engineering Commission which spoke of the great benefit that primary triangulation and precise leveling in the interior of Alaska would be to the general development of the interior of the country and especially in the extension of the railroads through the country.

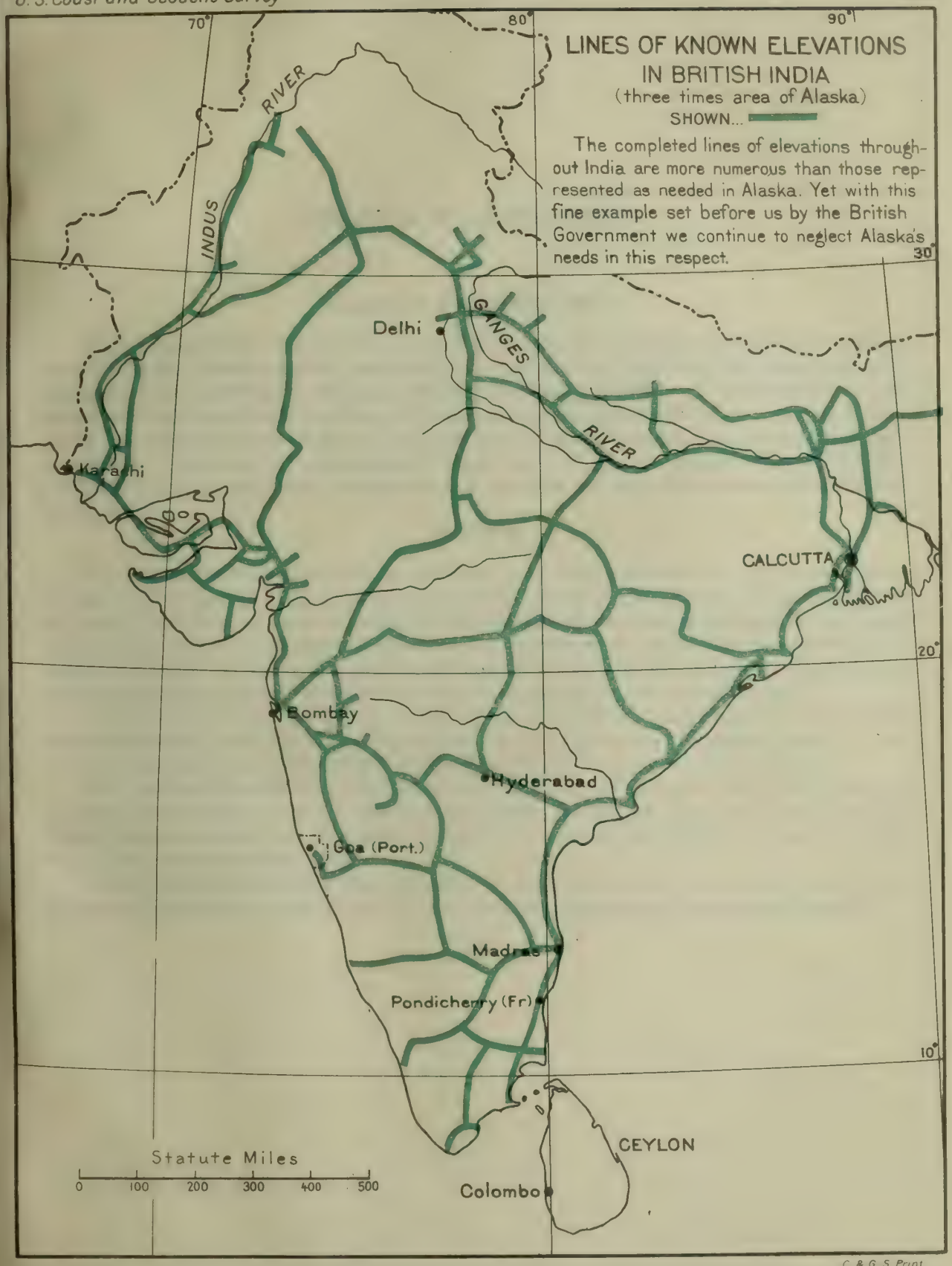
WHAT OTHER COUNTRIES HAVE DONE.

All countries of the world have carried on primary triangulation and precise leveling to a greater or lesser degree. Each one of the European countries except Russia is practically covered with triangulation and has many miles of precise leveling. Japan and India have completed the greater portion of the geodetic work needed for the control of maps. Australia has made a good start in such work. Mexico has extended a system of primary triangulation across its territory along the ninety-eighth meridian. Chile and Argentina have made a good start in extending such control over their area. The time is certainly opportune to begin this work in Alaska and there should be no delay in doing so.

As an example of what should be done in a thickly populated country, there is shown (see figs. 49 and 50) the network of precise leveling and primary triangulation in India. It may not be necessary in Alaska, on account of many inaccessible mountain regions, to have so much of the first-class control work done as in India; but it is certain that we must have some.


FIRST SURVEYS
Completed in BRITISH INDIA
SHOWN
India has an area three times that of Alaska, yet the network of control surveys here shown is now complete while Alaska's need for interior work of this kind has been completely overlooked.
70°
80°
90°
30°
20°
10°
INDUS RIVER
GANGES RIVER
Delhi
CALCUTTA
Bombay
Hyderabad
Goa (Port.)
Madras
Pondicherry (Fr.)
CEYLON
Colombo
Statute Miles
0 100 200 300 400 500

C & G S Print


LINES OF KNOWN ELEVATIONS
IN BRITISH INDIA
(three times area of Alaska)
SHOWN...
The completed lines of elevations throughout India are more numerous than those represented as needed in Alaska. Yet with this fine example set before us by the British Government we continue to neglect Alaska's needs in this respect.
70°
80°
90°
30°
20°
10°
INDUS RIVER
GANGES RIVER
Delhi
Karachi
CALCUTTA
Bombay
Hyderabad
Goa (Port.)
Madras
Pondicherry (Fr.)
CEYLON
Colombo
Statute Miles
0 100 200 300 400 500

CHAPTER V.—CONCLUSION.

ALASKA'S GREATEST NEED.

There should be the most serious thought given now as to taking care of Alaska's greatest need. The war should not delay preparation for the work, as immediate provision looking to the care of the preliminaries will mean the saving possibly of years. If authorization can be secured for new vessels and launches, all plans and specifications for building them will be prepared, and when the moment arrives bids and awards can be handled without any delay, and if authority is granted for the additional officers needed, then immediate filling of the new positions will result, and when the vessels and launches are ready the trained officers will be ready, too.

FUTURE.

It is safe to predict, and with proper emphasis, that Alaska will reach out in the near future looking to development along all lines and through every possible channel. Her next 10 years will most likely place her far in advance of what the past 50 years have produced and all assistance possible should be forthcoming from the mother country upon whom the responsibility rests. We should be well prepared in every branch of the home government to facilitate the commercial government and competition that will surely follow the close of the war.

Let it be hoped that the day is at hand when it will be no longer necessary to discover uncharted pinnacle rocks by the loss of some vessel, and the custom of commemorating the loss by naming the hidden rock after the unfortunate craft will be impossible in the future.

The Coast and Geodetic Survey, which in this field should have been the pioneer, showing the way for commerce to reach each new enterprise, has instead been following impotently behind, charting dangers less from data obtained by its own surveys than from reports of vessels which have been wrecked on them.

It is high time that such a state of affairs be corrected, yet it will now take years before the surveys can reach a point where they can even meet the needs of the present commerce.

VK
597
U55
1918

U.S. Coast and Geodetic Survey
Safeguard the gateways of
Alaska

[redacted]

PLEASE DO NOT REMOVE
CARDS OR SLIPS FROM THIS POCKET

UNIVERSITY OF TORONTO LIBRARY

UTL AT DOWNSVIEW
D RANGE BAY SHLF POS ITEM C
39 09 08 17 09 001 8